ESSAYS ON FISCAL POLICY, EXTERNAL BALANCE, AND TRADE LINKAGES OF THE OMANI ECONOMY

By

Salwa Al Jabri

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Salwa Al Jabri

Hobart, Tasmania

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DEDICATION

In memory of Oman’s visionary leader Sultan Qaboos bin Said (1940,2020), who promised to build a prosperity future for Oman and fulfiled his promise.

ABSTRACT

For many developing oil exporting economies, oil revenue contributes to a relatively high percentage of government revenue and to the value of export commodities. The high dependency on oil revenue has raised concern about the impact of oil price shocks on these economies and their vulnerability to oil price fluctuations. In the modern Omani economy, petroleum is a vital economic sector. In 2018, the petroleum sector contributed (i) 40.8% to Omani real gross domestic product (GDP), (ii) 65.3% to Omani's total exports, and (iii) 78.2% to Omani's government revenue (NCSI, 2019). A survey by the Central Bank of Oman highlighted a drastic fall in oil prices could be a threat to financial stability in Oman (CBO, 2016b).

The first essay of this thesis studies the impact of oil price shocks on fiscal policy and real GDP in the Sultanate of Oman. It employs a Structural Vector Autoregressive (SVAR) model with quarterly frequency data from 1989Q4 to 2016Q4. Impulse responses, variance decomposition analysis, and historical decomposition show that an oil price shock can have a significant impact on government revenue and GDP. An oil price shock explains around 22% and 46% of the variation in the government revenue and GDP, respectively. Decomposing the government revenue and GDP further into petroleum and non-petroleum related components, we find that an oil price shock explains around 26% of the variation in petroleum revenue and 90% of the petroleum-GDP. Petroleum and non-petroleum GDP respond positively to oil price shocks, while they respond negatively to oil price volatility. Government expenditure is not affected by oil prices, but it is affected by government revenue. This result demonstrates that government revenue is the channel through which oil price shocks impact government expenditure. The results also illustrate that the Omani government uses its reserve fund, and local and international debt to smooth, and reduce the impact of oil price fluctuations.

The second essay examines the Twin Deficits Hypothesis on the relationship between fiscal and trade balances for Oman, where the fiscal balance heavily relies on oil export revenue. According to the twin deficit hypothesis, the casual effects run from fiscal balance to trade balance. For example, a rise in the budget deficit through tax cuts or government expenditure increases, raises the domestic absorption through import expansions, leading to current account deficit. Therefore, the Twin Deficit Hypothesis may hold for countries where the government expenditure is largely funded through tax revenue. Compared to that, for oil-reliant economies like Oman, taxes contributed only 9.18% of the government revenue in 2018 while oil contributed 78.24% of the revenue. In this paper, we use the SVAR model and a Structural Vector Error Correction (SVECM) model to assess the relationship between Oman's fiscal and trade balances in the short and long-run. The results show that in the short run, Oman's trade balance and fiscal balance are mostly determined by oil price movements, where both balances respond positively to oil price shocks and negatively to oil price volatility shocks. The trade balance's response to oil price shocks is quantitatively larger compared to fiscal balance, while

fiscal balance's response to oil price volatility shocks is larger than trade balance. The fiscal balance responds positively and is statistically significant to trade balance shocks, while the responses of the trade balance to the fiscal balance shocks are statistically insignificant. In the long-run, oil price shocks have a statistically significant positive impact on fiscal revenue, exports, and imports. These results provide strong evidence that in Oman, the casual effect runs from the trade balance to the fiscal balance. In comparison, the fiscal balance is more endogenous, and the Omani government is able to adjust the fiscal policy in response to fluctuations in the oil price and trade balance, thus contradicting the traditional twin deficit hypothesis. We argue that for an oil-dependent small open economy, like Oman, policies that help to diversify away from depending heavily on oil revenue would help the economy to absorb international oil price shocks more effectively.

The third essay of the thesis investigates the impact of the global shocks on the Omani economy through trade linkages using the Global Vector Autoregressive (GVAR) model. The main objective is to assess the impact of shocks originating from Oman's main trading partners, namely China, Japan, Korea, Singapore, Thailand, and the United States. To our knowledge, this is the first study to use the GVAR model to assess shock transmissions to Oman. The GVAR framework allows us to present augmented VAR models that include both domestic and foreign variables such as output, inflation, short-term and long-term interest rates, and exchange rates along with oil price as a global variable. The period of study is from 1989Q4 to 2016Q4. The GVAR model enables us to carry out a rich analysis of the direct and indirect impact of shocks from Oman's trading partners on its real GDP, petroleum GDP, and non-petroleum GDP. In addition, the use of different trade weights enables us to account for the changing trade patterns over time. The empirical results highlight that any unexpected shocks originating from East Asian economies will have a significant impact on the Omani economy. The impact of China is growing over time and currently has the largest effect, while the impact of Japan is declining. In general, the impact of the United States is modest and similar across times. The trade concentration and over-reliance on a particular destination and commodity could be risky for Oman and thus the Omani government should consider diversifying its trade relation and the composite of products that it exports.

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1 Introduction

1.1 Motivation

Oil price, like other industrial commodities, depends on supply and demand as a consequence of global business cycle fluctuations (Kilian, 2009; Baumeister & Kilian, 2016). A growing body of literature recognizes the importance of oil price shocks for different types of economies, beginning with the assessment on the United States followed by the analysis on other developed countries. Thus, the impact of oil price shocks on developed countries is reasonably well documented. [1]

Over the past decades, oil revenue contributed a relatively high percentage to government revenue and export commodities value for oil-exporting developing countries. The dependency on oil revenue raised concerns about the impact of oil price shocks on these economies and their vulnerabilities in dealing with oil price fluctuations. Therefore, oil price shocks are an important source of economic fluctuations for oil-exporting developing countries, and a large and growing body of literature investigates the impact of oil prices on macroeconomic variables and policies of these economies.[2]

For oil-exporting developing countries, fiscal policies are the propagation channel of oil price shocks to the economy (Alley, 2016). In these countries, oil contributes a high percentage to government revenue, and the oil revenue is mainly managed by the government. In addition, government expenditure has a dominant role in the economy (Al-Faris, 2002; Tazhibayeva et al., 2008; Arezki & Ismail, 2013; Alley, 2016). Further, in oil-exporting countries with fixed exchange rate regimes, fiscal policy is assigned to adjust the impact of oil price shocks on macroeconomic conditions (Koh, 2016).

Oil exporting developing countries tend to be less diversified and heavily dependent on oil revenue, leading to a strong linkage between public saving and the current account balance (Arezki & Hasanov, 2013). The degree of economic diversification determines the relationship between the oil price and the current account, which determines the economy's ability to absorb oil price shocks. For developing oil-exporting countries with low trade diversification, the current account balance is

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[1] See for example Darby (1982); Hamilton (1983); Burbidge and Harrison (1984); Mork (1989); Mork et al. (1994); Lee et al. (1995); Hamilton (1996); Balke et al. (2002); Cooper (2003); Cuñado and de Gracia (2003); Bollino (2007); Kilian and Murphy (2012); Baumeister and Kilian (2016).

[2] See for example Eltony and Al-Awadi (2001); Olomola and Adejumo (2006); Mehrara and Oskoui (2007); Mehrara (2008); Farzanegan and Markwardt (2009); Berument et al. (2010); Dissou (2010); Farzanegan (2011); Mehrara and Mohaghegh (2011); Emami and Adibpour (2012); Al-Abri (2013); Esfahani et al. (2013); Hamdi and Sbia (2013); Dizaji (2014); Alley (2016); Hou et al. (2016); Koh (2016).

strongly linked to oil price changes, indicating a relationship between the current account and oil prices (Gnimassoun et al., 2017). Thus, with each oil price drop, these oil exporters must deal with two deficits due to the gap between the market oil prices and the external and fiscal breakeven oil prices.

In the modern Omani economy, petroleum is a vital economic sector that contributed 41.8%, 40.4%, and 40.8% to Omani GDP in 2016, 2017, and 2018, respectively. Petroleum is also the main exported commodity and its contribution to Omani exports was 57.9%, 58.2%, and 65.3% in 2016, 2017, and 2018, respectively. Oil is also the main source of government income and contributed 68.19% 72.89% and 78.24% to government revenue in 2016, 2017, and 2018, respectively (NCSI, 2019). A recent survey by the Central Bank of Oman showed that oil price decreases are considered the greatest threat to financial stability in Oman (CBO, 2016b).

Gulf Cooperation Countries (GCC) – including Oman, have a large public expenditure resulting from high wages, extensive public employment, and subsidies (Al-Faris, 2002). Even among oil-producing countries, the GCCs are claimed to have the highest government size by measuring the government expenditure by non-oil GDP, and high correlation between oil prices and government spending (Tazhibayeva et al., 2008). Two-thirds of the government spending in Oman is classified as current expenditure, of which 73.5% was salaries in 2018 (NCSI, 2019).

Both the fiscal stance and trade balance are linked to oil prices. While the realized oil price is fluctuating, the fiscal breakeven oil price is increasing steadily over time. The external breakeven oil price is also increasing but is lower compared to the rise in the fiscal breakeven price. The current realized oil price is below these breakeven prices, which results in the trade deficit and fiscal deficit. For example, between 2015 and 2016 the oil price dropped by 29.03%, and the fiscal balance deficit as a percentage of GDP increased from 17.2% in 2015 to 20.8% in 2016 and the current account deficit increased from 15.7% of GDP in 2015 to 18.6 % of GDP in 2016. The current account deficit in 2016 was largely attributed to a substantial decline in merchandise trade reflecting low crude oil prices.

The exports plus imports as a percentage of GDP is generally more than 90% in Oman, classifying it as a super trading nation, and Oman’s export commodity, oil, has a strong relationship with global economic activities. The Asian market is the main export destination for oil, as it is one of the most dynamic regions in global trade and a major driver of global economic growth. In addition, the boom and rapid growth of China over the past decades has been one of the main drivers of the rise in demand and prices of mineral commodity and energy. Therefore, oil exports to China have evolved over time. Currently, China is the main export destination, where up to 78%, 77%, and 83 of Oman’s oil exported to China in 2016, 2017, and 2018 respectively (NCSI, 2019). This raises concerns about the Omani economy’s vulnerability to the global shock in general and to one large trade partner in particular.

As oil is an exhaustible resource, with fluctuating prices that are sensitive to the international market, this imposes fiscal challenges and uncertainty for oil-exporting countries (Le & Chang, 2013). Given the importance of oil price in trade and fiscal stances, it poses challenges to policymakers in oil-exporting developing countries. For example, when oil price declines the export revenue declines, tightening the government's major revenue leading to trade and fiscal deficit. Moreover, high government spending and low realized oil price in specific times, escalated the public debt and the debt service costs. This further puts more pressure on the government to achieve fiscal consolidation, sustainability, and to move forward for diversification and pursuing deficit reduction. By pivoting on the oil price and Oman being the oil exporting country, this thesis examines issues relevant to the Omani economy, namely the roles of oil prices in fiscal policy and economic growth, its relevance to the twin deficits hypothesis, and on the transmission of shocks from the Oman's major trading partners.

1.2 Structure of the thesis

The dissertation consists of five chapters. Chapters Two to Four present three self-contained essays. The last chapter concludes, highlights the policy implications and future research directions. The three self-contained essays move from examining the effects of oil price shocks on Oman's (i) GDP and the fiscal balance; (ii) external trade and fiscal balance nexus; and (iii) trade linkages and shock transmissions from its main trading partners.

Chapter Two, titled 'Oil price shocks, fiscal policy, and implications for the Omani economy', explores the impact of oil price swings on the Omani macroeconomic and fiscal policy. This chapter investigates the impacts of an oil price shock on Oman's government revenue, government expenditure, and GDP. Additionally, it examines the influence of fiscal policy on economic growth. The study uses the structural vector autoregressive (SVAR) framework with six variables, namely: oil price, exchange rate, government revenue, government expenditure, inflation, and GDP.

The study provides a comprehensive dynamic effects analysis of the oil-dependent Omani economy. To study the cause and effects of subcomponents, a number of different specifications of government revenue, government expenditure, and GDP are included in the analysis. These subcomponents include petroleum and non-petroleum revenue, current government expenditure and investment government expenditure, and petroleum and non-petroleum GDP. According to Hausmann and Rigobon (2003), oil price volatility is found to be harmful for growth, investment, and income distribution. To capture the effects of an increase in oil price volatility, we re-estimate the models where the oil price is replaced with oil price volatility.

Chapter Three titled 'Trade and fiscal balances in an oil-based economy – the Omani experience', explores the Twin Deficits Hypothesis on the relationship between fiscal and trade balances for Oman. According to the twin deficit hypothesis, the casual effects run from fiscal balance to trade balance. This assumption may hold for countries where the government expenditure is largely funded through tax revenue, but the Omani economy is an oil-reliant economy, where the fiscal balance heavily relies on oil export revenue.

The chapter investigates the nexus of trade balance and fiscal balance and it includes the oil price and oil price volatility into the analysis. First, the chapter analyses the short-run relationship between oil price, trade balance, and fiscal balance using the structural vector autoregressive (SVAR) framework. Besides the full period analysis (1989Q4-2017Q4); to provide valuable insight into the twin deficit nexus over time, the study analyses the relationship between oil price, trade balance, and fiscal balance in three different sub-periods. We breakdown the study period into 1989Q4-1996Q4, 1989Q4-2006Q4, and 1989Q4-2013Q4 as each sub-period includes events such as the Kuwait invasion, Asian Financial Crisis (AFC), and Global Financial Crisis (GFC) respectively. The chapter also analyses the long-run relationship between oil price, exports, imports, government revenue, and government expenditure using structural vector error correction model (SVECM).

Chapter four titled 'The transmission of the global shocks to the Omani economy through trade linkages', investigates the impact of the international shocks on the Omani economy. The exports plus imports as a percentage of GDP is generally high for Oman and the oil commodity, which is Oman's main export commodity, has a strong relationship with global economic activities. The study explores the impact of trade shocks originating from Oman's main trading partners which received 89.5% of Omani oil export value in 2019 (NCSI, 2020). The trade partners are the United States, China, Japan, Korea, Thailand, and Singapore. The chapter assesses the bilateral spill over to the Omani economy through trade linkages using Global Vector Autoregressive (GVAR) model. So, the policy implications are based on a close inspection of the relationship between Oman and its trading partners, as the trade relationship varies from country to country.

The GVAR framework allows us to include both domestic and foreign variables such as output, inflation, short-term and long-term interest rates, and exchange rates along with oil price as a global variable. Using GVAR, the study carried out a rich analysis of the direct and indirect impact of shocks from Oman's trading partners on its real GDP, petroleum GDP, and non-petroleum GDP due to the importance of petroleum to the Omani economy as the main export commodity and economic activity. In addition, we use different trade weights to account for Oman's changing trade patterns over time. Finally, due to the importance of the United States monetary policy to the Omani economy, as the Omani currency is pegged to the US dollar since 1973, the chapter studies the impact of US expansionary monetary policy shocks on the Omani interest rate and exchange rate.

Overall this dissertation gives an overview of the Omani economy in the global context. In the three main chapters, we explore three different but connected issues; i.e. is from fiscal stance to trade balance and the impacts of global shocks on small oil-dependent developing economy. The results affirm the need for economic diversification for the oil-dependent Omani economy and provide empirical evidence and policy recommendations that help in evaluating the current situation and for future planning.

CHAPTER 2

2 OIL PRICE SHOCKS, FISCAL POLICY AND THE IMPLICATIONS FOR THE OMANI ECONOMY

2.1 Introduction

The 1970s oil price shock caused by reductions in oil supply by the Organization of the Petroleum Exporting Countries (OPEC), followed by a global recession, drew attention to the impact of oil price fluctuations on macroeconomy. A growing body of literature recognizes the importance of oil price shocks for many different types of economies, beginning with the impact on the United States (US), followed with an impact examination on other developed countries. Thus, the impact of oil price shocks on developed countries is reasonably well documented. [3]

An oil price shock is an essential issue for oil-exporting countries. Over the past five decades, oil revenue has contributed a relatively high percentage to government revenue and exports value, especially for oil-exporting developing countries. This dependency increased the concern about the impact of oil price shocks on these economies and raised concerns on how vulnerable countries deal with oil price fluctuations challenges. A recent obvious example of this is the shift in the current account balance in oil-exporting countries in the Middle East and North Africa; i.e. from 8.8% as a percentage of gross domestic products (GDP) surplus to 3.6% deficit between 2014 and 2016 (IMF, 2017). Therefore, recent research has focused on the effects of oil price swings on oil-exporting economies. [4]

The objective of this study is to investigate the impacts of oil price shocks on Oman's government revenue, government expenditure, and GDP (petroleum and non-petroleum), and additionally to examine the influence of fiscal policy on economic growth. The motivation for this research is the consequences of recent oil price drops from more than 100 US$/BBL in 2014 to less than 30 US$/BBL in 2016.[5] As a result, there was a fiscal budget deficit in Oman, and government expenditure decreased by 9.7% and 6.5% in 2015 and 2016 respectively. The value of exports declined

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[3] See for example Darby (1982); Hamilton (1983); Burbidge and Harrison (1984); Mork (1989); Mork et al. (1994); Lee et al. (1995); Hamilton (1996); Balke et al. (2002); Cooper (2003); Cuñado and de Gracia (2003); Bollino (2007); Kilian and Murphy (2012); Baumeister and Kilian (2016).

[4] See for example Eltony and Al‐Awadi (2001); Olomola and Adejumo (2006); Mehrara and Oskoui (2007); Mehrara (2008); Farzanegan and Markwardt (2009); Berument et al. (2010); Dissou (2010); Farzanegan (2011); Mehrara and Mohaghegh (2011); Emami and Adibpour (2012); Al‐Abri (2013); Esfahani et al. (2013); Hamdi and Sbia (2013); Dizaji (2014); Alley (2016); Hou et al. (2016); Koh (2016).

[5] A barrel (BBL) is a form of measuring oil in terms of unit volume (159 litres), https://www.petropedia.com/definition/4727/barrel-bbl-oil-production.

by 23% in 2016 while the nominal GDP contracted by 16% and 5.2% in 2015 and 2016 respectively.[6] Rating agencies downgraded the credit rating of the Omani debt in 2015, 2016, and 2017.[7] These events explicitly show the sizable impact that oil has on Omani government revenue, exports, and output. The government reacted to these events in several ways. It removed the subsidy on fuel products in 2016, restructured corporate taxes in 2017, and plans to impose 5% value-added taxes in April 2021. The government established two new units in the Ministry of Finance: Fiscal Policy and Debt Management Office.

Oil-exporting economies have experienced many dramatic oil price fluctuations in the previous decades, caused by different reasons. For example October 1973-early 1974 the October war and oil embargo, October 1978-February 1979 Iranian revolution, September 1980 Iran-Iraq war, August 1990 invasion of Kuwait, March 1999 OPEC meeting (Barsky & Kilian, 2004), 2003-2008 global economic expansion, 1998 Asian Financial Crisis, 2008 Global Financial Crisis and recent improvement in the shale resource production in North America. The impacts of these oil price shocks have varied across oil-exporting countries, depending on the percentage of the oil sector's contributions to export, government income, and GDP (Arezki & Blanchard, 2014), and the ability of the government to boost the economy with countercyclical policy through monetary and fiscal policies. Further, because of the government expenditure stickiness and the high percentage of oil revenue in the total government revenue, oil-exporting countries face considerable challenges in adapting to oil price swings (Arezki & Ismail, 2013).

We use six variable vector autoregressive (VAR) model in this study with quarterly data from 1989 to 2016 from the National Centre for Statistics and Information (NCSI). The variables are oil price, exchange rate, government revenue, government expenditure, inflation, and GDP. For a better understanding of the effect of oil price shocks on Oman's fiscal situation and economy, we include a number of different subcomponents of government revenue, government expenditure, and GDP in our analysis. These subcomponents include petroleum and non-petroleum revenue, current government expenditure and investment government expenditure, and petroleum and non-petroleum GDP. To capture the effects of increasing oil price volatility in the last decades, we examine the impact of oil price volatility on the Omani economy where the oil price volatility is replaced for the oil price in the model.

Our results show that oil price shocks affect both government revenue and GDP in Oman. Oil price shocks explain 18.65% of the government revenue in the 1st quarter following the shock, and 55.22% of the GDP. The impact is even higher on petroleum government revenue and petroleum GDP.

[6] From different issues of the statistical yearbook, NCSI, Oman
[7] https://tradingeconomics.com/oman/rating visited in 27/10/2017

However, government expenditure only fluctuates and then stabilises within six quarters. When examining the subcomponents of government spending, current government expenditure does not respond to oil price shocks, while investment government expenditure responds negatively. Considering the impact of government revenue and government expenditure, GDP responds positively and significantly to both variables' shocks. The results indicate that oil price, government revenue, and government expenditure have an impact on the economic growth in Oman. This is expected for a developing oil exporter, where the government is the guardian for the natural resource, and it is the conduit for the oil revenue to the economy (Mehrara & Oskoui, 2007). The higher export revenue from oil price influences the government's spending towards expansionary fiscal policy (Akanbi, 2015). The results also show that oil price shocks appreciate the exchange rate, a classic symptom of the Dutch disease (Arezki & Ismail, 2013).[8] For the model specified with oil price volatility, the oil price volatility has a negative impact on government revenue, government expenditure, and GDP.

The paper is structured as follows: section 2.2 gives a review of oil price and fiscal policy; section 2.3 includes an overview of the Omani economy. Section 2.4 describes the data and introduces the methodology, and section 2.5 discusses the empirical results. The last section, section 2.6, includes the conclusion and the policy implications.

2.2 Review on oil price and fiscal policy

Oil, like other industrial commodities, depends on supply and demand as a consequence of global business cycle fluctuations (Kilian, 2009; Baumeister & Kilian, 2016). There are three types of oil price shocks: oil supply shock, aggregate demand shock, and oil-specific demand shock (Kilian, 2009). Oil price fluctuation caused by changes in the global economy and the political conditions, affect the supply and demand for oil (Devlin & Titman, 2004). The reason behind the resource rent volatility is that the natural resource supply has low price elasticity (Hausmann & Rigobon, 2003). Thus, an increase in oil price volatility in the short run could be due to the steeper oil supply and demand curves. Consequently, any possible surplus in oil demand or shortage in oil supply creates a price jump and this largely explains the high oil price volatility, since the oil producer could not increase their supply immediately to meet the demand (Kilian et al., 2009; Baumeister & Peersman, 2013). Oil price is more volatile than 60% of the crude commodities in the US, and it stems from the relatively high storage cost of oil, seasonality of oil demand, concentration of oil supply in specific geographic areas, and that OPEC is the key producer (Regnier, 2007).[9] In addition, the use of spot market deals and short-term oil

[8] The Dutch Disease is a process of a boom in a natural resource sector that results in shrinking the non-resource tradables, leading to specialization in the resource and non-tradable sectors leaving the economy more vulnerable to resource-specific shocks (Ismail, 2010).
[9] In 2016 Middle East, Eastern Europe and Eurasia, and OPEC produce 35%, 16.9% and 44% respectively of the world crude oil production. In term of world proven crude oil reserve: Middle East has 54%, Latin America has 22.7% and 81.5% for OPEC (OPEC Annual Statistics Bulletin 2017).

future contracts instead of long-term oil contracts, encourages speculative activities and inventory practices (Baumeister & Peersman, 2013).

The short-run price fluctuations are caused by economic or political instabilities. On the other hand, long-run oil price changes result from shocks such as finding a new substitute for oil, the discovery of new reserves or improvements in extraction technology (Devlin & Titman, 2004). A recent example, is the improvement in the technology used for extracting shale resources (oil and natural gas) in North America (Huntington, 2015).

The transmission channel of oil price shocks differs between importing and exporting countries. In oil-importing countries, oil is a significant input in their economic activities (Regnier, 2007). For these oil importers, high oil prices increase the cost of production, reduce economic growth, decrease the productivity, increase inflation, and can even cause a recession (Barsky & Kilian, 2004). Hamilton (1983) found that the increase in the oil price contributed to the US post-second World War recession. Hamilton (1996) explains that high energy prices draw attention to energy availability and prices which may affect the investments decisions by increasing the uncertainty of the investment reward. This is likely to lead to the investment being postponed for firms but also a decrease in consumer demand for goods such as motor vehicles and electrical products. Therefore it causes a negative impact on durable consumption, industrial production, and GDP (Elder & Serletis, 2010).

For oil-exporting countries, fiscal policies are the propagation channel for oil price volatility to the economy (Alley, 2016). For these countries, oil contributes a high percentage to government revenue, and the oil revenue is mainly managed by the government, and government expenditure has a dominant role in the market (Al-Faris, 2002; Tazhibayeva et al., 2008; Arezki & Ismail, 2013; Alley, 2016). Moreover, in oil-exporting countries with fixed exchange rate regimes, fiscal policy is the only policy mechanism assigned to adjust the impact of oil price shocks on macroeconomic conditions (Koh, 2016).

Developed and developing countries react differently to the business cycle. Developing countries typically follow procyclical fiscal policy; i.e. during an economic boom period, the government spending as a share of GDP and fiscal deficit increases, while in a recession it decreases (Alesina et al., 2008). Arezki and Blanchard (2014) claim that the impact of oil price decline on the macroeconomy depends on the monetary and fiscal policy arrangements. Most developed countries react with a countercyclical policy to boost the economy during a crisis period, while many developing countries follow a procyclical trend (Frankel et al., 2013). Several studies have indicated that procyclicality is more explicit in countries with abundant natural resources and commodity exporters (Fasano & Wang, 2002; Talvi & Vegh, 2005; Frankel, 2010). The Gulf Cooperation Countries' (GCCs) fiscal policy tends to be procyclical with international oil prices (Al-Faris, 2002; Fasano & Wang, 2002).

High government consumption leads to fiscal policy volatility because of the availability of ‘easy money’ from natural resources and aid inflow (Bleaney & Halland, 2014). Coupled with limited ability to forecast revenue because of oil price volatility, this leads to an increase in government spending over the government revenue in the short run (Alley, 2016). Lack of financial depth, imperfect access to international credit markets, (Caballero & Krishnamurthy, 2004), and political instability (Talvi & Vegh, 2005) are possible explanations for procyclical policy in developing countries. These also explain the responses of oil-exporting countries to oil price swings (Erbil, 2011). Taken together, a high percentage of commodities in export, weak institutions, a lack of trust between the government and people, and corruption explain why resource-dependent economies may suffer more from fiscal volatility compared to non-resource-dependent economies.

Most oil-exporting countries have established saving and stabilizing funds to cope with the impact of oil price uncertainty and volatility (Collier et al., 2010). Fiscal policy stabilization, future generation saving, and controlling the impact of inflow payments on local inflation are also reasons for establishing saving funds (Aizenman & Glick, 2009). These funds are widely used by OPEC countries to react to oil price fluctuations (Erbil, 2011). Hausmann and Rigobon (2003) suggest that the importance of saving funds appears strong in relation to oil price shocks. These funds create continuous revenue from exhausted natural resources, increase governments’ ability to deal with oil revenue shortfalls and create a balance between revenue and expenditure. Therefore, saving funds can be used to break the relationship between fiscal spending and oil prices (Devlin & Titman, 2004).

The amount of resource revenue and population size are two determinants that explain the variation in the saving level among oil exporters. In countries with a small population and an abundant oil resource, the surplus revenue in boom times adds to the saving fund. In contrast, this is difficult for countries with a high population since the surplus may be exhausted before any anticipated oil price drop (Devlin & Titman, 2004).

Most oil-exporting countries have established saving funds; in 2015 around 60% of Sovereign Wealth Funds are oil and gas funds (Koh, 2016). Compared with other developing countries, developing countries with saving funds show better governance in terms of government effectiveness, control of corruption, and regulatory quality (Aizenman & Glick, 2009).

The ability of saving funds to support macroeconomic stabilization during a negative oil price shock is still debated and the empirical evidence on the influence of saving funds is mixed (Koh, 2016). Devlin and Titman (2004) argue that savings and stabilization funds cannot be used to smooth investment expenditures, and therefore, oil price volatility will significantly affect the efficiency of the country's infrastructure investment program. In contrast, Fasano and Wang (2002) explain that the relatively smooth responses from both Oman and Kuwait, compared to other GCCs is that both countries have adopted formal oil saving funds for more than two decades. Devlin and Titman (2004) report that government spending in Oman, Chile, and Norway varies less compared with other countries because of the impact of their savings funds.

In order to benefit from saving funds, the funds should be professionally managed in terms of supervision, reporting, and accountability. For example, Norway's Norges Fund (currently ranked number one globally), the Ministry of Finance is the supervisory body for the sovereign fund in terms of investment, reporting, and evaluation. Parliamentary approval is needed for any transfer (Devlin & Titman, 2004). Compared to that, in Oman, decisions are mainly taken by the government; in order to use the saving fund to finance the general budget, the Ministry of Finance is expected to approve the financial affairs and energy resource council recommendation (Fasano, 2000).

The Oman General Reserve Fund is one of the seven sovereign funds established before 1990 (Koh, 2016). It was established in 1980 to manage and invest any surplus revenue from oil and gas to diversify government income and secure future generations. This surplus includes what exceed from approved five-year development proposed oil price, surplus of the financial year, and the fund's investment revenue. It is independent and supervised by the Ministry of Finance.[10,11] A high percentage of the saving fund is invested abroad, and only a small portion is held by the Central Bank of Oman as foreign currency (Fasano, 2000).

To summarise this section, oil price shocks are an important issue for developing oil-exporting countries, and a growing body of literature investigate the impact of oil prices on macroeconomic and fiscal policy reported in Appendix 2.A. The most common variables used in these studies are output, exchange rate, inflation, government revenue, and government expenditure. The literature survey also shows that vector autoregression (VAR) model and vector error correction (VECM) model are widely used methodologies. As the Middle East produces 35% of the world crude oil, there is a number of country-specific studies like Kuwait and Iran to examine the impact of oil price shocks on the macroeconomy.

This study provides a comprehensive dynamic analysis of an oil-dependent economy, Oman. It is not only studying the petroleum and non-petroleum segment of the economy, but it takes a step forward to break down the revenue into petroleum and non-petroleum, the government expenditure into current and investment to carry out an extensive analysis of the oil price shocks. The study also analyses the impact of oil price volatility on Oman. Oil price volatility has been perceived to be damaging for economic growth, investment, income distribution, and educational attainment (Hausmann & Rigobon,

[10] https://www.sgrf.gov.om/Index.php?r=en%2Fsite%2Fabout

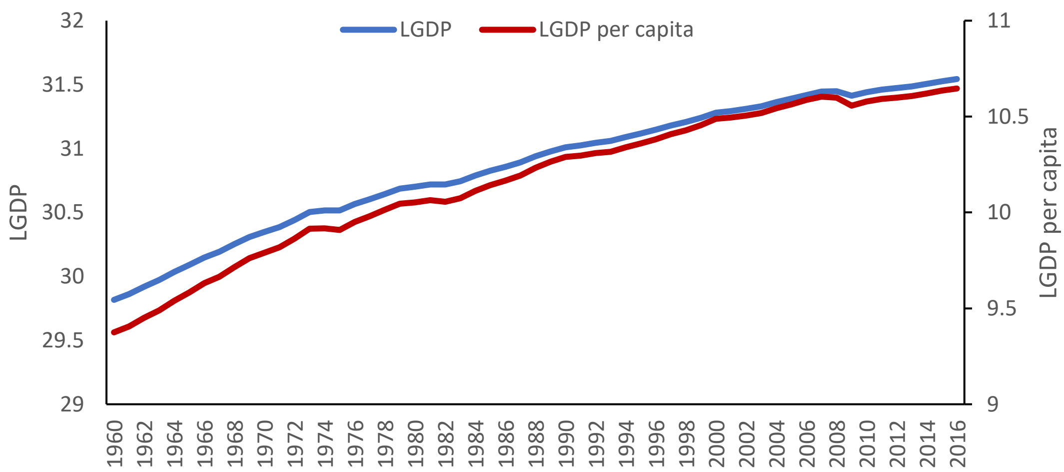
[11] Five-year development plan is introduced by the government to maximize the economic and social benefit from oil asset, each plan set a number of short-term goals, the first development plan was from1976 to 1980 (Al-Saqri, 2010), the current plan is the 9th development plan from 2016 to 2020.

2003). The outcome of this study can be used as a guide for policy targeted not only for Oman but for other oil-dependent economies, particularly in the Middle East. Effective independent fiscal policy actions are essential for oil exporters to deal with oil price fluctuations; for instance, the oil-exporting government can use non-oil primary balance as a guide for policymaking (IMF, 2018).

2.3 Overview of the Omani economy

The Omani economy is an oil-dependent economy. Over the last forty years, the petroleum sector has been the main economic activity, government income, and export commodity for the country. On average, it has contributed up to 80% of the government's revenue, 60% of export value, and 40% of the GDP (NCSI, 2017). Oil has been the main generator of economic growth since it was discovered in 1964 and then exported three years later (Al-Saqri, 2010). This free natural gift leads to a transition stage in the economy, and the gross domestic product and per capita increased dramatically as Figure 2.1 shows the logarithm of GDP (LGDP) and the logarithm of GDP per capita (LGDP per capital) from World Development indicators published by the World Bank (WB).

Figure 2.1. The GDP and per capita GDP (1960- 2016)



Source: World Development Indicators from the World Bank database, constant 2010 US$.

The measurement scale of LGDP and LGDP per capita is in logs.

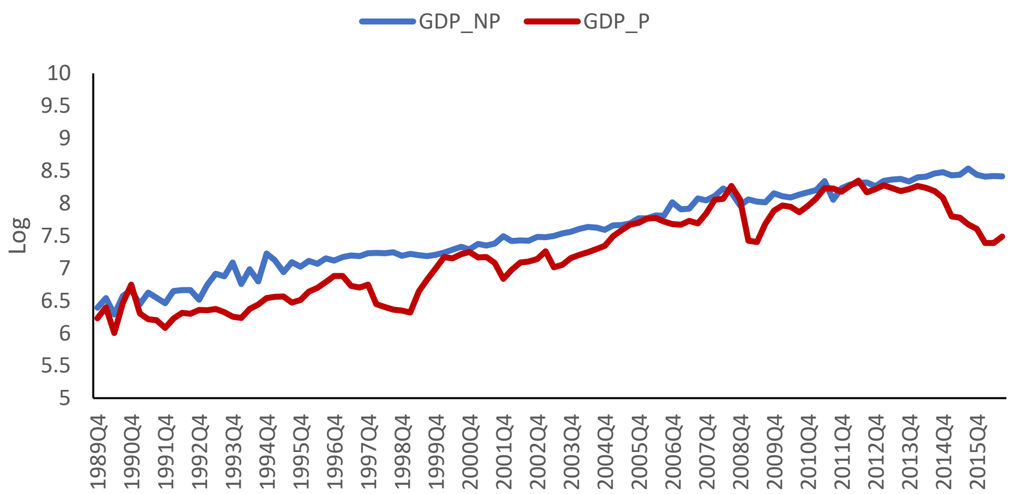
Oman achieved good economic growth, and is considered as one of thirteen countries in the world with sustained economic growth in the post-war period (WB, 2008).[12] Oil price volatility and reserve exhaustibility are two critical problems for oil-dependent economies (Devlin & Titman, 2004).

[12] Botswana, Brazil, China, Hong Kong (China), Indonesia, Japan, Republic of Korea, Malaysia, Malta, Oman, Singapore, Taiwan (China) and Thailand.

In Oman, oil price fluctuations and oil depletion are the two main challenges that face policymakers in sustaining economic growth. Oman's share in the total global proved reserve is only 0.3% and the reserves to production ratio, which gives the length of time remaining if the production rate continues on the same rate, is 14.6 years (this information is based on the end of 2016 statistics).[13] A recent survey by the Central Bank of Oman showed that oil price decreases are considered the greatest threat to financial stability in Oman (CBO, 2016b).

The petroleum sector is the main economic activity; it has contributed up to 40% of GDP. The remaining 60% of non-petroleum GDP is dominated by service activities for around 40%, industry activities for 19% and agriculture and fisheries for 1.6% (NCSI, 2017).[14] As Figure 2.2 displays, petroleum GDP (GDP_P) fluctuates considerably compared to the non-petroleum GDP (GDP_NP), while its growth rate is relatively lower than the non-petroleum GDP.

Figure 2.2. Petroleum and non-petroleum GDP



Sources: Different issues of the monthly statistical bulletin, NCSI.

Both the fiscal stance and trade balance are linked to oil prices. Figure 2.3 shows that a high percentage of the total export value is sourced from petroleum and it follows the trend of the oil price. For instance, the value of petroleum exports declined from 66% in 2014 to 58% in 2015 because oil prices dropped by 45% in 2015 compared to 2014 even though the annual volume production of crude

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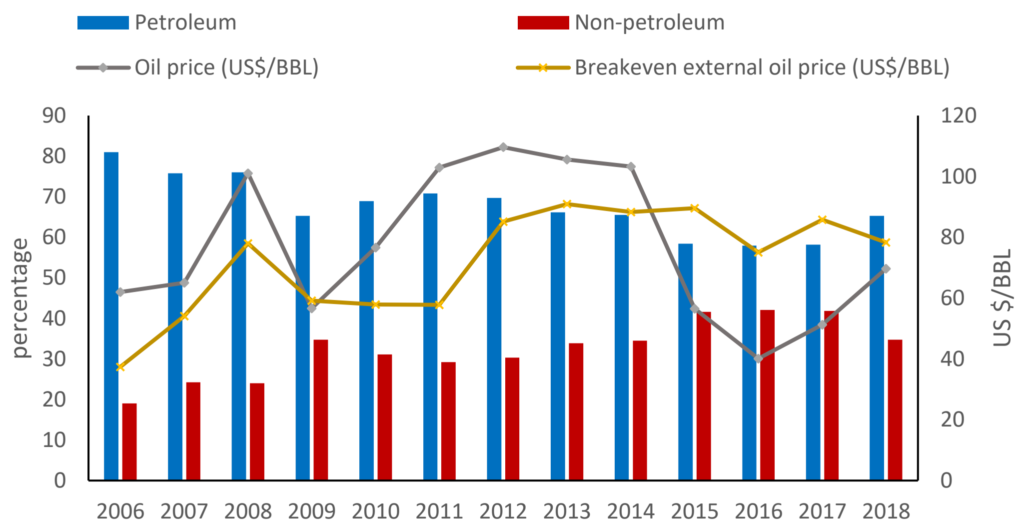
[13] BP statistical review of world energy, June 2017.
[14] Industry activities include mining and quarrying, manufacturing (refined petroleum products, chemicals and chemicals products and other manufacturing), electricity and water supply and constructions.
Services activities include wholesale and retail trade, hotels and restaurants, transportation, storage and communication, financial intermediation, real estate and business activities, public administration and defence, education, health, other community, social and personal services and employed people in private households.

oil increased by 5.4% in 2015 (NCSI, 2017). Sometimes, this decline in the percentage of petroleum value export is misunderstood and interpreted as an improvement in the non-petroleum export value.

Figure 2.3 also shows the breakeven external oil price on the right vertical axis.[15] It shows when the oil prices were 103, 57, and 40 US$/BBL in 2014, 2015, and 2016, the breakeven external oil prices were 88, 90, and 75 US$/BBL respectively. As a result, the current account balance dropped as Figure 2.4 shows. Another important point to note from Figure 2.4, is that despite oil price fluctuations, the breakeven fiscal oil price increased gradually from less than 50 US$/BBL in 2005 to more than 100 US$/BBL in 2015.[16] This creates a challenge for the government to adjust to oil price drops and creates a gap between government revenue and government expenditure as Figure 2.5 illustrates. Therefore, the government debt (as a percentage of GDP) increased dramatically to 4.9%, 15.4%, and 33.3% of the GDP in 2014, 2015, and 2016 as Figure 2.4 shows.

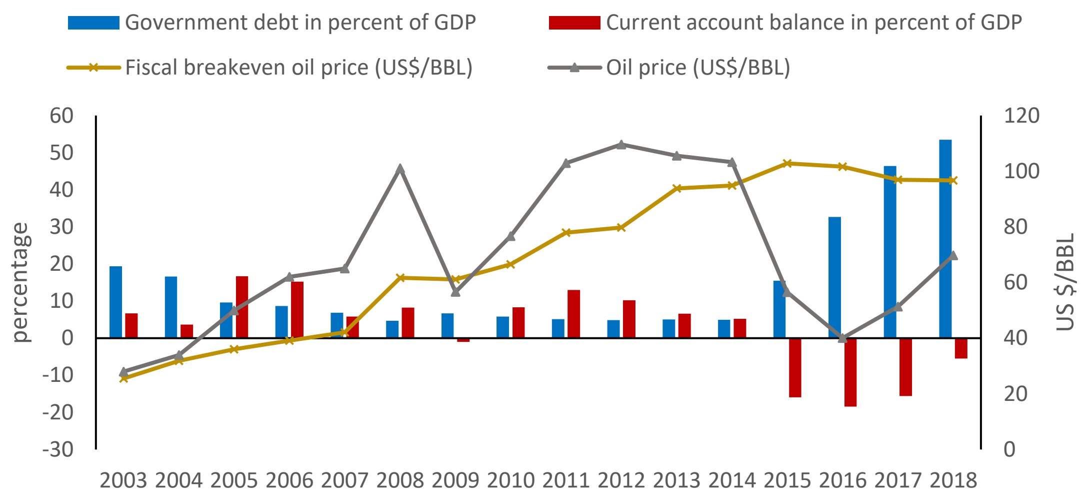
Figure 2.3. Percentage of petroleum and non-petroleum from the export value, oil price and breakeven external oil price (2006-2018)



Source: Different issues of the statistical yearbook, NCSI, and IMF.

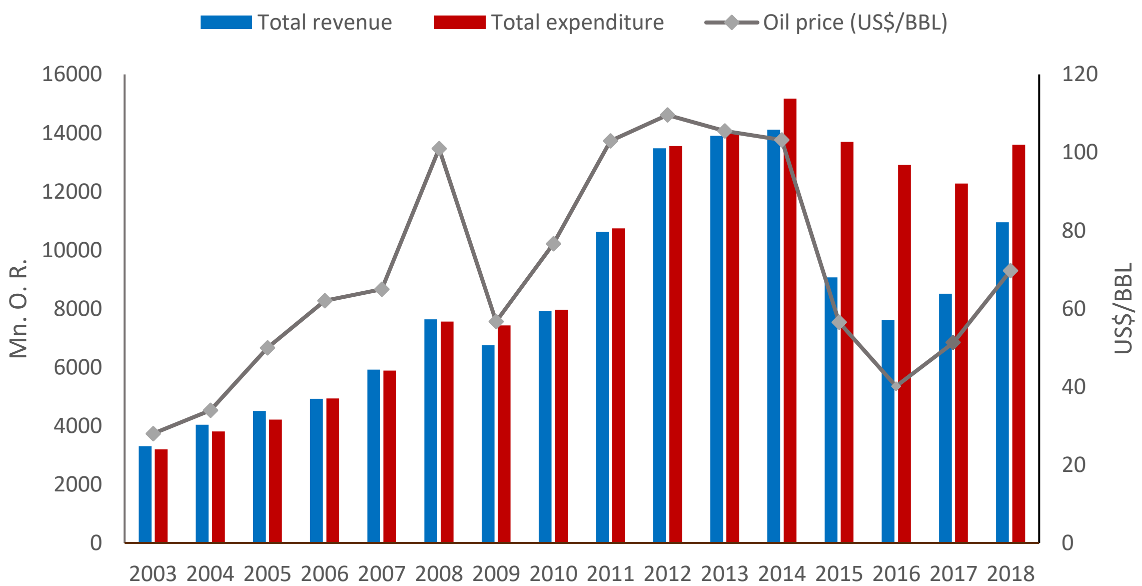
[15] External breakeven oil price: the oil price at which the current account balance is zero.
[16] Fiscal breakeven oil price: the oil price at which the fiscal balance is zero.

Figure 2.4. Oil price, fiscal breakeven oil price, government debt, and current account balance (2003-2018)



Source: Different issues of the statistical yearbook, NCSI, and IMF.

Figure 2.5. Oil price, government revenue and expenditure (2003-2018)



Sources: Different issues of the statistical yearbook, NCSI, the value are in million Omani Rial (Mn.O.R), O.R.1 = US$ 2.6.

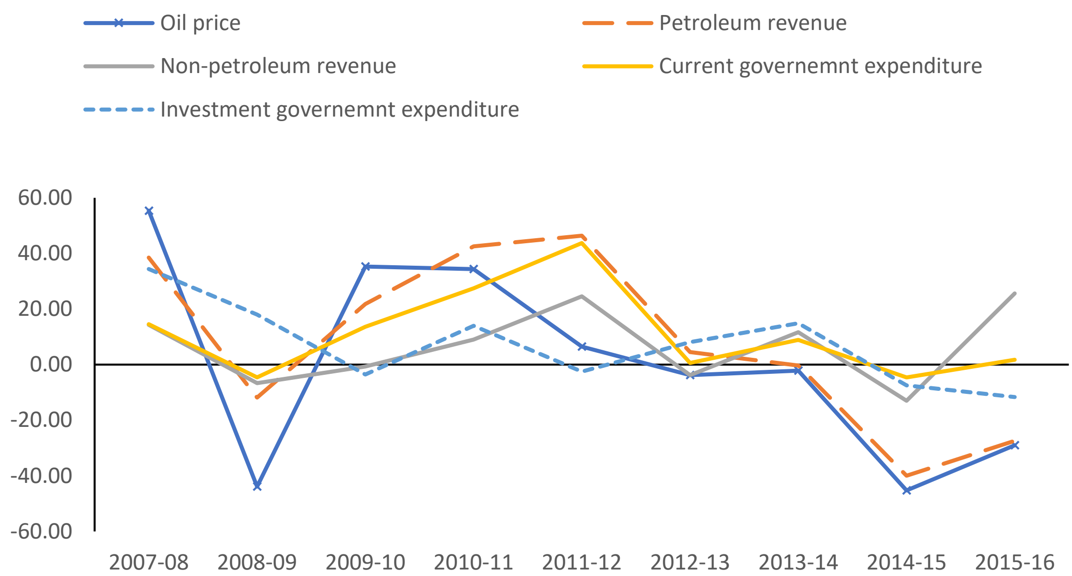
GCCs, including Oman, have large public expenditure resulting from high wages, extensive public employment, and subsidies (Al-Faris, 2002). Even among oil-producing countries, the GCCs are claimed to have the highest government size by measuring the government expenditure by non-oil GDP, and high correlation between oil prices and government spending (Tazhibayeva et al., 2008). Fasano and Wang (2002) found that government expenditure increased by 1% when oil revenue increased by

1% in Oman, Bahrain, and Kuwait. In Oman, the annual public budget depends on the anticipated oil price for that year. Figure 2.6 shows the petroleum government revenue fluctuates more compared to non-petroleum government revenue.

Two-thirds of the government spending in Oman is classified as current expenditure, of which 72.8% is salaries in 2016 (NCSI, 2017). In early 2011, a protest started in Oman along with the "Arab Spring'' movement, forcing the government to provide redundant jobs just to content job seekers. Consequently, as shown in Figure 2.6, the current government expenditure increased by 27.4% between 2010 and 2011 and by 43.8% between 2011 and 2012. It also shows that investment expenditure fluctuates less than current expenditure. Based on national data, about 27.6% of the Omani are between 18 and 29 years old.[17] A survey done by the NCSI reveals that 7 out of 10 graduate students prefer to work for the public sector.[18] Figure 2.7 shows the percentage of current and investment government expenditure between 1989Q4 and 2016Q4. Remarkably, the percentage of investment spending has increased between 2005 and 2011. This may be due to recent government spending on the new airport, seaports, and free zone areas. As a high percentage of government expenditure is current spending, the government does not have enough space to reduce spending when the oil price falls, Table 2.1 shows the fiscal surplus and deficit as a percentage of the current expenditure between 1980 and 2016. The number shows that the deficit is 51% and 57% of the current spending in 2015 and 2016 compared to only 21% and 16% in 1998 and 2009, respectively. Consequently, the commodity-rich countries accumulate debt because public spending is not adjusted sufficiently to accommodate falls in commodity prices (Arezki & Bruckner, 2010). This puts more pressure on the government to achieve fiscal consolidation, sustainability, and to move forward for diversification and pursuing deficit reduction. Generally, the deficit is funded by reserves and by local and international public debt. As the deficit increases, a vicious cycle is initiated and a high percentage of government expenditure is paid to debt and debt services (Al-Fazari, 2006).

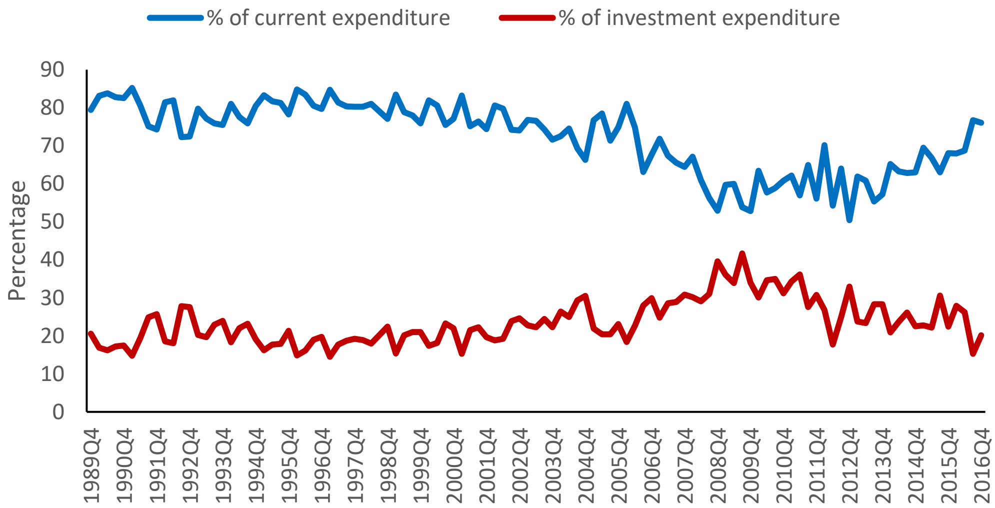
[17] Youth and work, a bulletin published in Omani Youth Day, 26/10/2016, NCSI.
[18] Preference of the Omani youth in the job market, NCSI.

Figure 2.6. The rate of change in oil price, petroleum and non-petroleum government revenue, current and investment government expenditure



Source: Different issues of the statistical yearly book, NCSI.

Figure 2.7. The percentage of current government expenditure and investment government expenditure



Source: from different issues of the monthly statistical bulletin, NCSI.

Table 2.1. Fiscal year balance (1980-2016)

Fiscal year	**1980**	**1985**	**1990**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Surplus or deficit as a percentage of current expenditure	-4	-27	-1	-26	-14	-2	-21	-26	-17	-14	4	6	9
Fiscal year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Surplus or deficit as a percentage of current expenditure	10	1	1	2	-16	-1	-2	-1	-1	-11	-51	-57	-38

Source: Different issues of the statistical yearly book, NCSI.

Subsidy expenditure is the third and smallest component of government expenditure. The government provides a wide range of non-targeted subsidies. This includes support for development loan interest payments, housing loan interest payments, electricity and fuel products, food commodities, and investment and operational expenditure for government companies (NCSI, 2017). As a consequence of the recent oil price drop, the government removed the fuel products subsidy from 2016. Later the government provided a targeted subsidy for low-income people, students, and unemployed people.

Although oil booms play a vital role in improving the Omani economy, they have negative effects on the two main traditional economic sectors: agriculture and fisheries. Currently, both sectors contribute less than 3% of the non-petroleum GDP sector. An increase in government spending on social capital infrastructure and increases in living standards is likely to lead to an increase in the demand for imported commodities and services. Consequently, the economic structure tends towards the non-tradable sector (Mehrara & Oskoui, 2007). Currently, the service sector dominates the non-petroleum activities at 43.3%, 44.8%, and 44.3% in 2016, 2017, and 2018 respectively (NCSI, 2019), and contributes to creating a non-competitive industrial sector.

Asia is the main market for Omani crude oil. In 2018, Omani oil was exported mostly to China, India, and Japan for 83.1%, 7.6%, and 5.8% respectively (NCSI, 2019). Omani crude oil future contracts are used as flagship contracts by Dubai Mercantile Exchange Limited (DME) which was established for Middle Eastern crude oil exports to Asia.[19]

2.4 Data and methodology

Time series data and vector autoregressive (VAR) model is used in this analysis. In this section, we discuss the choice of variables and their properties. Consistent with the literature, we use six

[19] http://dubaimerc.com/about-dme.

variables in the baseline VAR model: oil price, exchange rate, government revenue, government expenditure, inflation, and GDP. We also discuss issues concerning foreign block exogeneity restrictions and the identification of the contemporaneous structure. The model includes two blocks, oil price as the foreign block and the other variables as the domestic block. It studies the petroleum and non-petroleum segment of the economy, breaks down the revenue into petroleum and non-petroleum, the government expenditure into current and investment. The study also analyses the impact of oil price volatility on these components.

2.4.1 Data

Six variables are used to study the Omani economy as a small open economy. Oil prices represent the global exogenous factor, and the exchange rate is included representing the open economy nature of Oman. Government revenue and government expenditure are two fiscal policy variables, and inflation and GDP are two variables representing macroeconomic conditions. Generally, these variables are used to study the business cycle movements and are commonly used in the literature (see for example Eltony & Al‐Awadi, 2001; Farzanegan & Markwardt, 2009; Emami & Adibpour, 2012; Hamdi & Sbia, 2013; Dizaji, 2014). A detailed description of the variables can be found in Appendix 2.B.

The data source is a monthly statistical bulletin published by the National Centre for Statistics and Information (NCSI), the formal data provider for government data in the Sultanate of Oman.[20] The gross domestic product and consumer price index are provided quarterly, while government revenue (net revenue after transfer to the reserve fund), government expenditure, oil price, and the effective exchange rate index are monthly. For government revenue and government expenditure, three months of data are accumulated to get the quarterly data, while the average of three months of data is used for the oil price and effective exchange rate. The GDP deflator is not available for the whole period. Consequently, the consumer price index is used to convert the data from nominal to constant prices, to remove the price effects.

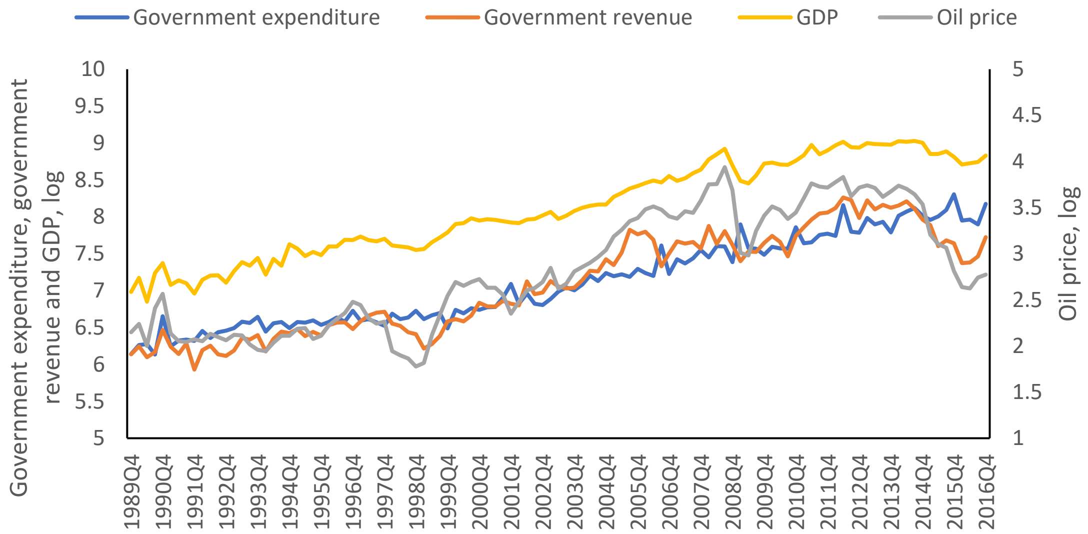
The period of study is from 1989Q4 to 2016Q4, and as shown in Figure 2.8, includes a number of oil price fluctuations responding to supply and demand shocks. There are periods of declining oil prices associated with Asian Financial Crisis (AFC) in 1998, the Global Financial Crisis (GFC) in 2008, and a recent drop because of the decline in global demand mainly from China and Europe, followed by an increase in US shale oil production and less impact of geopolitical conflict on the supply in the Middle East (Koh, 2016). There are periods of rising oil prices resulting essentially from geopolitical

[20] The first monthly report published in November 1989 and included data for the earlier three months only.

unrest in exporting countries such as the Kuwait invasion (1990), Iraq invasion (2003), and ‘Arab spring’ (2011) as well as an increase in global oil demand (2003-2008).

Figure 2.8 shows the log of real GDP, government revenue, and government expenditure on the left vertical axis, while the log of real oil price on the right vertical axis. There is a co-movement between the four variables with an upward trend. The graph clearly shows the fall in oil price, GDP, and government revenue in 1998, 2008, and since late 2014. It is worth noting as the oil price spikes, the government revenue in Oman does not spike in tandem. This observation is expected as the published government revenue is actually the net revenue after transfer to the reserve fund if the oil price in that period is higher than the anticipated price for a specific five-development plan. In terms of the relationship between government revenue and government expenditure, they are both trending closely upwards. However, in periods where revenue falls, the spending does not respond which reflects the smoothing policy undertaken by the Omani government plus a large chunk of government expenditure is current spending, dominated by salaries. Hence, this provides the government with less space to adjust the expenditure.

Figure 2.8. The GDP, government revenue, government expenditure, and oil price



Source: Different issues of the monthly statistical bulletin, NCSI.

The first step, before applying the VAR model, is to test the data for stationarity using three different tests; Augmented Dickey- Fuller (ADF), Philips –Perron (PP), and Kwiatkowski-Philips-Schmid-Shin (KPSS). As appendix 2.C shows, the results are not consistent across the three tests if the variables are expressed in level and mostly are integrated of order I(1), while it is more consistent for the variables to be stationary in first difference, I(0). Therefore, all data are expressed in the logarithmic first difference in the vector autoregressive framework.

2.4.2 The SVAR model

In order to study the impact of oil price shock on the Omani economy, the six variables described in the previous section are ordered as follows: oil price (OP), exchange rate (EX), government revenue (GR), government expenditure (GE), inflation (IN), and GDP.

$$y_t = [OP, EX, GR, GE, IN, GDP]'$$

The macroeconomic relationship among these variables is modelled using a structural vector autoregression model (SVAR):

$$\mathbf{B}_0 y_t = \mathbf{B}_1 y_{t-1} + \cdots + \mathbf{B}_p y_{t-p} + \varepsilon_t \qquad (2.1)$$

Where y_t is $(N \times 1)$ vector of the endogenous variables at time t. The dimension of $\mathbf{B}_0$ is a $(N \times N)$ matrix that illustrates the contemporaneous relationship between the variables. The $\mathbf{B}_i$ where $i = 1, \ldots, p,$ show how each variable is affected by its own lag as well as by lags of the other variables and ε_t is a $(N \times 1)$ vector of structural disturbances mutually uncorrelated with white noise properties. In this research, one lag is used based on lag order selection criteria results reported in Appendix 2.D.

Since ε_t and $\mathbf{B}_0, \ldots, \mathbf{B}_p$ cannot be estimated in equation (2.1), we estimate through the reduced form of (VAR) model which can be expressed as

$$y_t = \mathbf{A}_1 y_{t-1} + \cdots + \mathbf{A}_p y_{t-p} + e_t \qquad (2.2)$$

Here we have $\mathbf{A}_1 = \mathbf{B}_0^{-1}\mathbf{B}_1$and $\mathbf{A}_p = \mathbf{B}_0^{-1}\mathbf{B}_p$ and $e_t = \mathbf{B}_0^{-1}\varepsilon_t$

This matrix allows us to express the typically mutually correlated reduced form innovation (e_t) as weighted averages of the mutually uncorrelated structural innovations (ε_t) and the elements of B_0^{-1} serving as the weights.

We can express the reduced form equation (2.2) in terms of the lag operator:

$$y_t - \sum_{i=1}^{p} \mathbf{A}_i y_{t-i} = e_t$$

$$(I - \mathbf{A}_1 L - \mathbf{A}_2 L^2 - \cdots - \mathbf{A}_p L^P) y_t = e_t$$

$$\mathbf{A}(L) y_t = e_t \qquad (2.3)$$

So, $L^P y_t = y_{t-P}$ defines the lag operator and $\mathbf{A}(L) = I_N - \mathbf{A}_1 L - \cdots - \mathbf{A}_p L^p \qquad (2.4)$

and the inverse of (2.4) gives the vector moving average to identify the dynamic properties of the VAR

$$y_t = \mathbf{A}(L)^{-1}e_t = \mathbf{\Theta}(L)e_t = \mathbf{\Theta}(L)B_0^{-1}\varepsilon_t \qquad (2.5)$$

Where $\mathbf{\Theta}(\mathrm{L}) = \mathbf{\Theta}_0 + \mathbf{\Theta}_1 L + \cdots + \mathbf{\Theta}_q L^q$ therefore, the impact of a shock in ε_t on the dependent variables in the future $y_t, y_{t+1}, y_{t+2}, \ldots$ are respectively the $(N \times N)$ parameter matrices $\mathbf{\Theta}_0, \mathbf{\Theta}_1, \mathbf{\Theta}_2, \ldots$.

Through the moving average, we can get the impulse response function (IRF) and forecast error variance decomposition (FEVD). Impulse responses trace the impact of an unexpected shock in current and future errors of one variable on the other variables while holding other shocks constant. The forecast error variance decomposition (FEVD) is the percentage of the variance in the error of a variable associated with a specific shock in the model and depends critically on the orthogonality of underlying shocks (Stock & Watson, 2001).

As the Omani economy is a small open economy, the structure of the vector autoregressive (SVAR) model consists of two blocks. One block represents the exogenous external variable (oil price), and the second block represents the domestic fiscal policy and macroeconomic variables (exchange rate, government revenue, government expenditure, inflation, and GDP).

The oil price will affect the domestic variables contemporaneously and in lag, while the oil price is not affected by domestic variables contemporaneously nor in lag as Table 2.2 shows. Oil price is the most exogenous variable, as it reflects the relationship between supply and demand in the international market. Oman is a price taker and has no impact on the international oil price. In addition, Oman is not a member of OPEC, which may assume to have some influence on the oil price. While the oil price has an impact on the domestic block contemporaneously and in lag but not vice versa. In contrast, the domestic variables affect each other in lag and contemporaneously by using Cholesky decomposition order to get the orthogonalized residuals. So, the order of domestic variables started with the exchange rate, government revenue, government expenditure, inflation, and GDP.

Table 2.2. The relationship between oil price and domestic variables

Dependent	Independent variable					
Variable	OP	EX	GR	GE	IN	GDP
OP	*					
EX	*	*	*	*	*	*
GR	*	*	*	*	*	*
GE	*	*	*	*	*	*
IN	*	*	*	*	*	*
GDP	*	*	*	*	*	*

To identify the structural shock, the model should be exactly or over-identified. B_0 has K^2 parameters so we need at least $\frac{K(K-1)}{2}$ restriction to impose on B_0.

$$\begin{bmatrix} e_{OP,t} \\ e_{EX,t} \\ e_{GR,t} \\ e_{GE,t} \\ e_{IN,t} \\ e_{GDP,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{2,1}^{(0)} & 1 & 0 & 0 & 0 & 0 \\ \alpha_{3,1}^{(0)} & \alpha_{3,2}^{(0)} & 1 & 0 & 0 & 0 \\ \alpha_{4,1}^{(0)} & \alpha_{4,2}^{(0)} & \alpha_{4,3}^{(0)} & 1 & 0 & 0 \\ \alpha_{5,1}^{(0)} & \alpha_{5,2}^{(0)} & \alpha_{5,3}^{(0)} & \alpha_{5,4}^{(0)} & 1 & 0 \\ \alpha_{6,1}^{(0)} & \alpha_{6,2}^{(0)} & \alpha_{6,3}^{(0)} & \alpha_{6,4}^{(0)} & \alpha_{6,5}^{(0)} & 1 \end{bmatrix} \times \begin{bmatrix} \varepsilon_{OP,t} \\ \varepsilon_{EX,t} \\ \varepsilon_{GR,t} \\ \varepsilon_{GE,t} \\ \varepsilon_{IN,t} \\ \varepsilon_{GDP,t} \end{bmatrix} \qquad (2.6)$$

The model is exactly identified. For the domestic block, we expect the exchange rate (EX) to be affected contemporaneously only by OP. EX is weighted by the imports of major trade partners of the Sultanate. Oman has used a pegged exchange rate regime to the US dollar since 1973 (CBO, 2018a), and the US currency is the main pricing and settlement currency in oil transactions. The US dollar is affected by the US monetary policy, therefore, the fluctuations of the dollar play an important role in world oil prices (Hou et al., 2016). In addition, countries with abundant natural resources are expected to experience currency appreciation following an oil price hike. So, there is a direct relationship between oil and the exchange rate. The third variable is government revenue (GR), where about 80% is petroleum revenue and 20% from customs duties, corporate income tax, and other resources. Therefore, GR is assumed to be affected contemporaneously by the oil price and exchange rate. The fourth variable is government expenditure (GE). The government expenditure is divided into current expenditure (dominated by salaries) and investment expenditure (development and capital). We assume that GE is affected contemporaneously by the oil price, exchange rate, and government revenue. The fifth macroeconomic variable is inflation (IN). There are three reasons which explain the inflationary pressure in Oman; government spending, international prices, and the value of the US dollar (CBO, 2017). So, inflation is affected contemporaneously by all variables except GDP. Blanchard and Perotti (2002) indicate that “fiscal variables move for many reasons, of which output stabilization is rarely predominant, in other words, they are exogenous (with respect to output) fiscal shocks”. In the case of Oman, the fiscal variables move mainly for oil prices and social reasons. The last variable is gross domestic products (GDP) as a proxy for economic growth. GDP affected by all five variables in the model.

2.5 Empirical results and discussion

This section presents the results from impulse responses, variance decomposition, and historical decomposition of the baseline model. In addition, it reports the results from different specifications of the baseline model which include the subcomponents of government revenue, government expenditure, and GDP. In the last specification, oil price volatility replaces the oil price in order to study any possible different responses to the variable volatility.

2.5.1 Impulse response function

This section presents the results of the Impulse Response Function (IRF). The IRF traces the impact of structural innovations on the current and future value of other variables in the model. The graphs below are with 68% confidence intervals.

2.5.1.1 Baseline model

This section presents the results of the impact of oil price shocks and fiscal policy shocks in the baseline model which includes: $[OP, EX, GR, GE, IN, GDP]'$. Starting with the responses to oil price shocks, the exchange rate responds positively and significantly to the oil price shock as shown in the first graph in Figure 2.9. This appreciation is expected for countries with abundant natural resources and the result is consistent with Farzanegan and Markwardt (2009) finding for the Iranian economy. responding to oil price shock.[21]

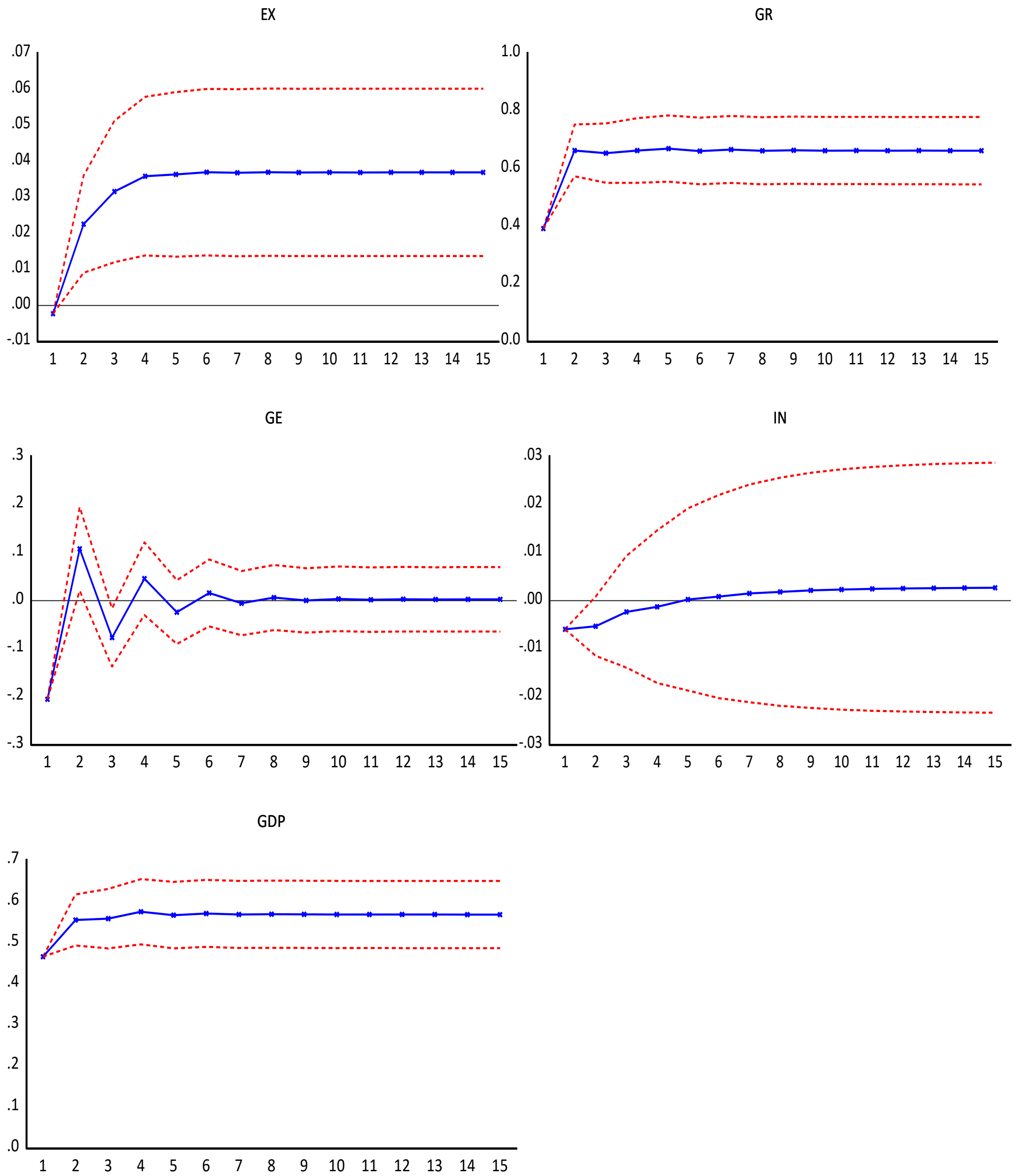
Total government revenue responds strongly and positively to the oil price shock as the second graph in Figure 2.9 shows. The response is statistically significant; this is expected since petroleum revenue contributes up to 80% of the total revenue. Contrary to expectations, the effect on government expenditure is relatively short-lived, stabilizing within six quarters. This result is consistent with Devlin and Titman (2004) and Fasano and Wang (2002) who included Oman within the oil-exporting countries for their studies. Moreover, the finding is similar to Farzanegan and Markwardt (2009), where they found only marginal impact of oil price shocks on the government expenditure in Iran. This negligible impact of an oil price shock reflects the ability of the government to smooth spending by (i) funding the deficit using the reserve fund when the oil prices drop, (ii) obtaining fund through local and international debts, and (iii) isolating the impact of oil price increase using reserve fund when the oil price increases (as mention earlier, if the oil price is higher than the anticipated price for a specific five-development plan, the excess goes to the reserve fund). Hamdi and Sbia (2013) highlighted that since

[21] In contrast, one study found that the exchange rate in Gulf countries does not appreciated as the oil price increased, because these countries pegged their currencies to the US dollar (Setser, 2007).

establishment of Future Generation Reserve Fund in 2006, the total government expenditure does not respond to oil revenue in Bahrain as not all oil revenue has been used for government spending.

The result also shows that GDP responds positively to the oil price shock. This is anticipated as petroleum activities contribute a high portion of GDP, i.e. around 40% of the total GDP. In contrast, the oil price shock has no impact on inflation in Oman; this may reflect the impact of the subsidies system in Oman.

Figure 2.9. Accumulative response to oil price shock



Note: The responses are in the y-axis and time index (quarters) in the x-axis in all graphs.

Next, we consider the impact of fiscal policy shocks i.e. government revenue and government expenditure shocks. Figure 2.10 illustrates the response to a government revenue shock. Both government expenditure and GDP respond positively and significantly to a government revenue shock. This indicates that the oil price affects government expenditure through government revenue.[22] However, inflation only responds slightly and is statistically insignificant to the government revenue shock.

Figure 2.10. Accumulative response to government revenue shock

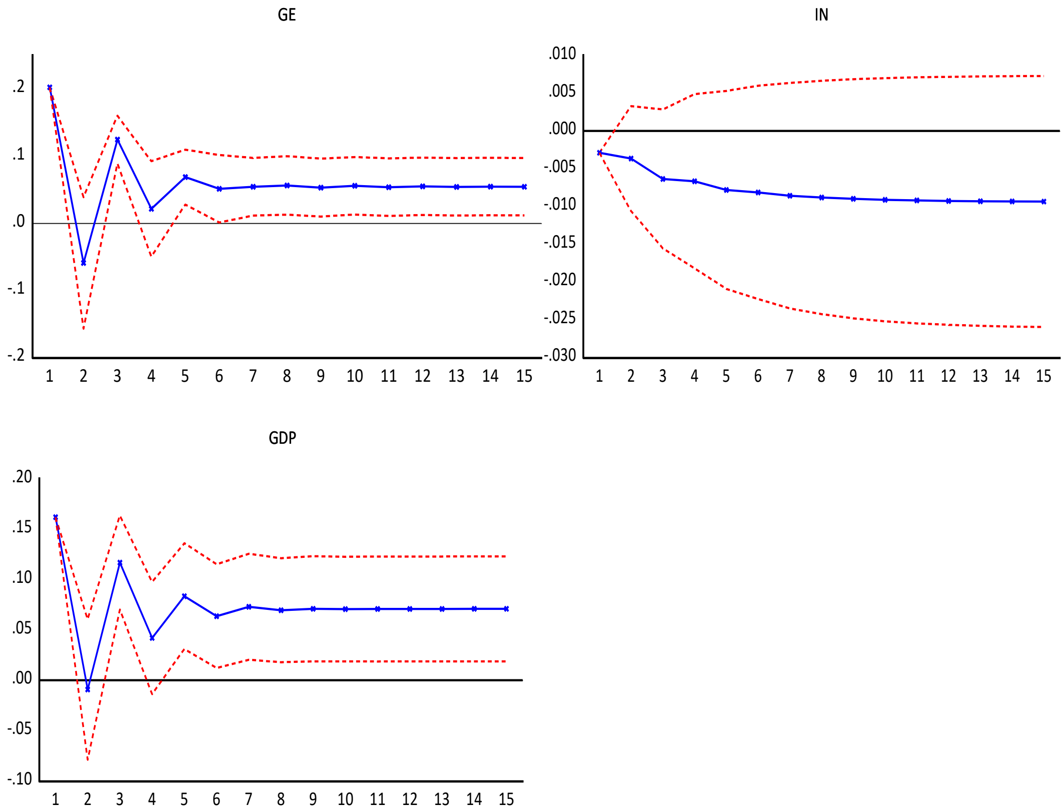
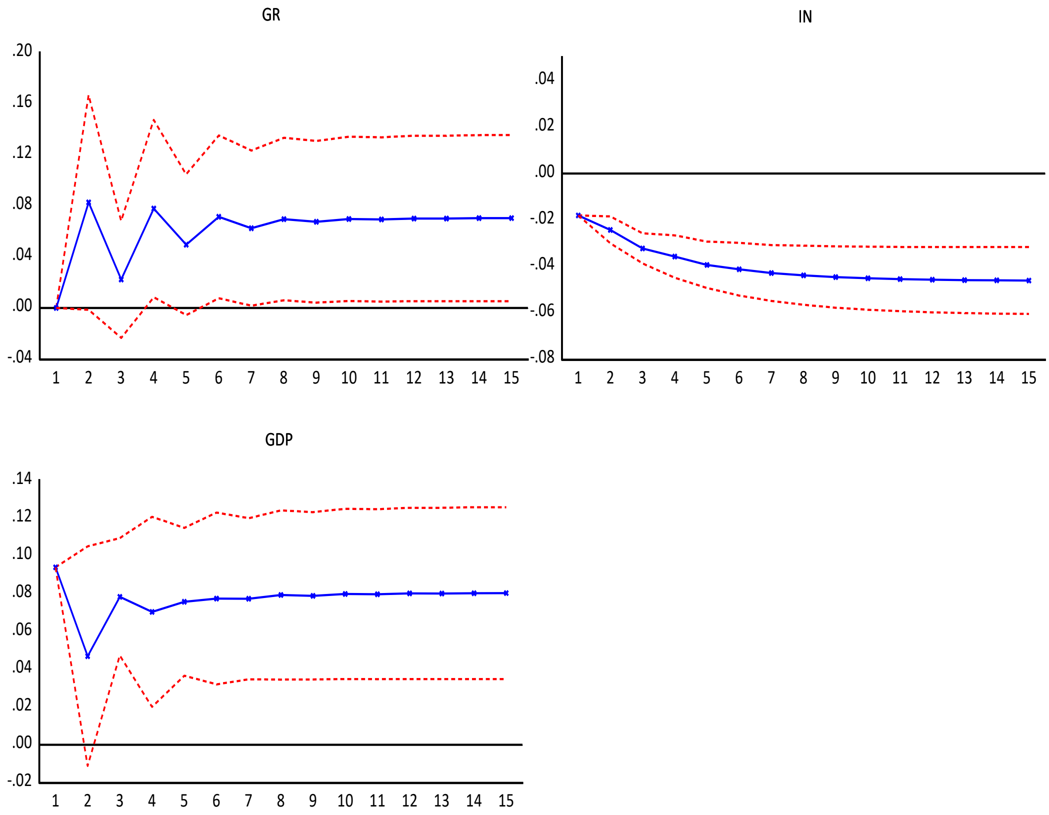


Figure 2.11 below illustrates the responses to government expenditure shock. Government revenue responds positively and marginally to government expenditure shocks. The GDP response is positive and statistically significant, highlighting the expansionary nature of government spending shocks. Compared to that, inflation responds negatively and significantly to the shock. The result is contrary to expectations since the government expenditure is one of the three reasons which explain the inflationary pressure in Oman; along with international prices and the US dollar value (CBO, 2017). This difference may be explained by three possible reasons: (i) the inflation in Oman is predominantly imported inflation, as it is a small open economy with pegged currency. Therefore it trends with the

[22] The correlation matrix for the structural residuals is uncorrelated.

global inflation (CBO, 2018b). (ii) The export plus import as a percentage of GDP, which is used as a measure for the openness of the economy (Huntington, 2015), is high in Oman. The trade openness as a percentage of GDP is 93.6% and 77.4% in 2015 and 2016, respectively. Moreover, import merchandise as a percentage of GDP is high; it is around 42.5% and 35.9% in 2015 and 2016 respectively (CBO, 2017). (iii) The subsidies system in Oman includes subsidies for food commodities, electricity sector, fuel products, and housing loans (NCSI, 2017). The model does not capture the source of inflation and as reported in Table 2.3, the variance decomposition results highlight that the variation in inflation is mostly due to its own shock.

Figure 2.11. Accumulative response to government expenditure shock



2.5.2 Different model specifications

This subsection presents different specifications of the baseline model; it includes the subcomponents of the government revenue, government expenditure, and GDP. As we notice earlier in the baseline model, inflation does not respond to the other variables in the model except to government expenditure. Therefore, inflation has been excluded from the extended model specifications. This exclusion is perceived to be fine as inflation in Oman is largely imported inflation, and as a small open economy with pegged currency, Oman’s inflation trends with the global inflation (CBO, 2018b).

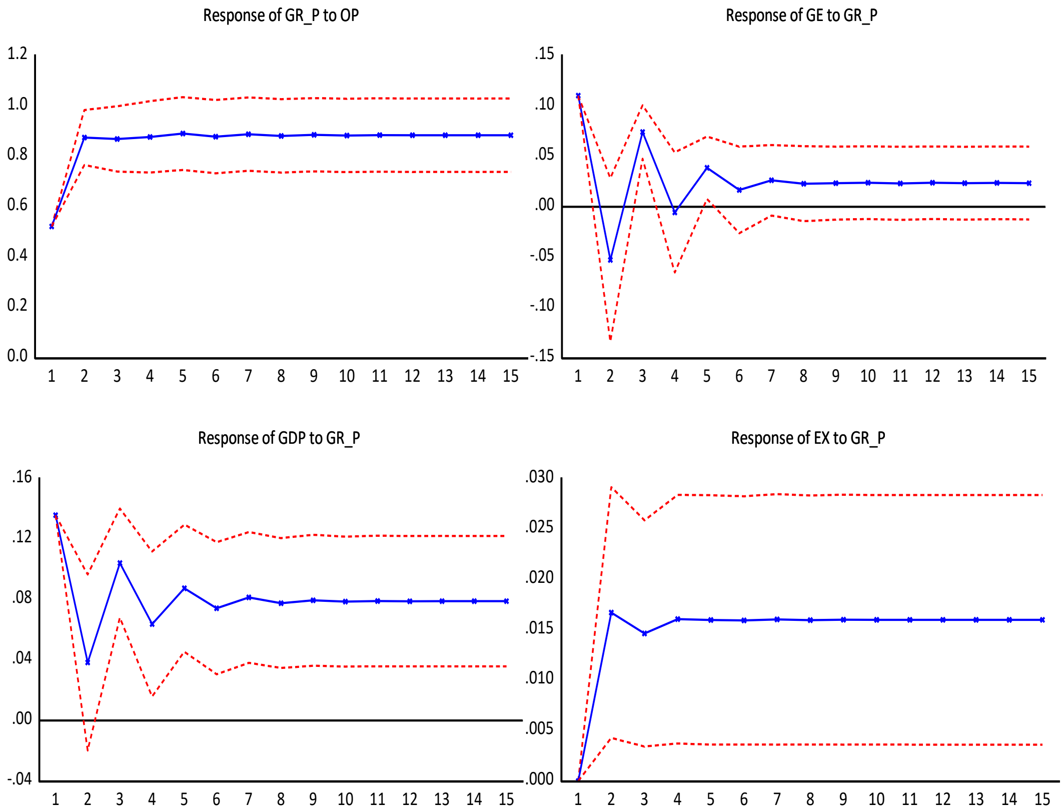
2.5.2.1 Petroleum government revenue versus non-petroleum government revenue

The next step will study the impact of petroleum government revenue and non-petroleum government revenue. In our first specification, we replace the government revenue with petroleum-government revenue (GR_P). As mentioned earlier, petroleum revenue contributes 80% of the total government revenue.

$$y_t = [OP, EX, GR\_P, GE, GDP]'$$

Figure 2.12 shows petroleum government revenue response is higher than the total government revenue to oil price shock, peaking at 0.9 for the former and 0.7 for the latter. The government expenditure response is minor and slightly statistically significant to a petroleum government revenue shock. The impact is slightly lower compared to the response to the total government revenue. This result may be explained in that the government expenditure does not react much to the petroleum government revenue and oil price changes. Oman adopted a formal saving policy as stated previously, and if the oil price is higher than the anticipated price for a specific five-development plan, the excess goes to the reserve fund. We notice that both GDP and exchange rate respond positively and significantly to the petroleum government revenue.

Figure 2.12. Model specification with petroleum government revenue

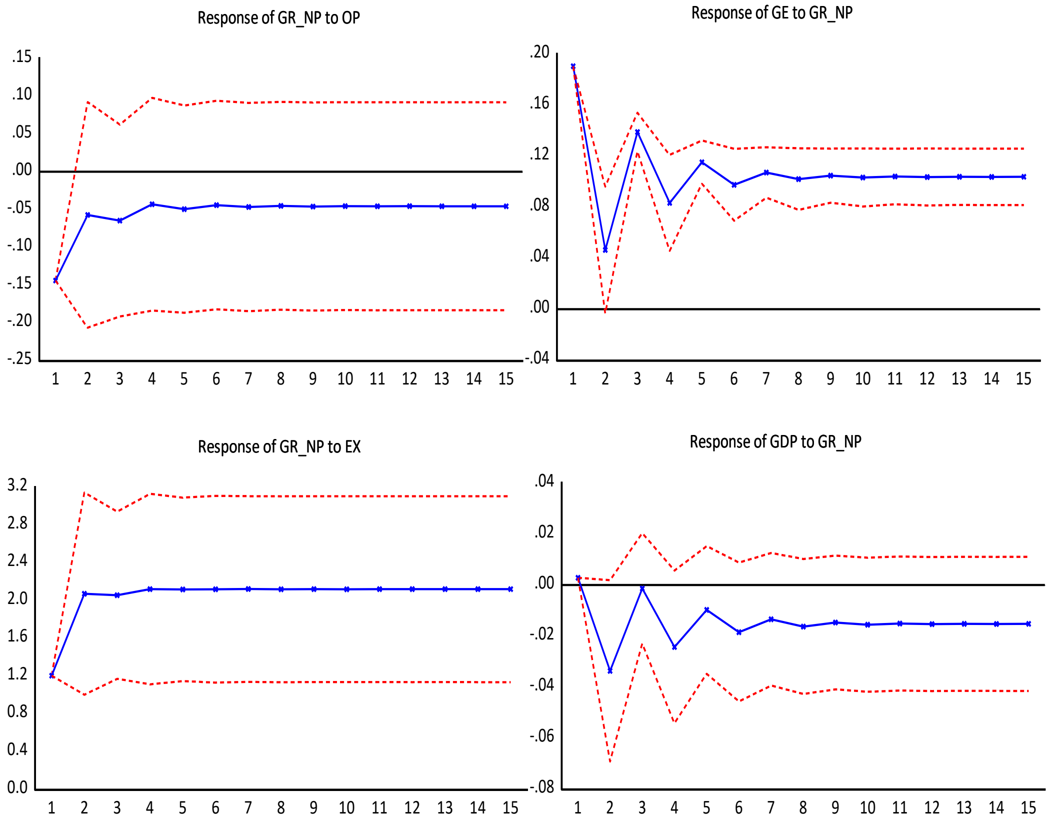


To examine the impact of non-petroleum revenue, we will replace the government revenue with non-petroleum government revenue in the second specification.

$$y_t = [OP, EX, GR\_NP, GE, GDP]'$$

Consistent with expectations, there is no response from the non-petroleum government revenue to the oil price shock as Figure 2.13 demonstrates. What is surprising is that government expenditure responds positively and statistically significant to the non-petroleum revenue even though it only contributes 20% of the total revenue. We also observe the non-petroleum revenue responds positively and significantly to the exchange rate. This may be associated to the contribution of custom duties in non-petroleum government revenue. The exchange rate used in this case is the trade weighted exchange rate, which is weighted by imports of major trade partners of the Sultanate. A rise in the index of the exchange rate in this case indicates that the purchasing power of the Omani rial is increasing. Therefore, as the exchange rate appreciates, we expect the ability of the Sultanate to import increases, and thus the government gain more revenue from the custom duties.

Figure 2.13. Model specification with non-petroleum government revenue



2.5.2.2 Current and investment government expenditure

In this subsection, we will examine the responses of subcomponents of government spending, current government expenditure (GE_C), and investment government expenditure (GE_I), to an oil price shock and government revenue shock. As mentioned previously, the current expenditure in Oman is dominated by salaries, which is less flexible compared to investment government expenditure. The variables in this specification are ordered as follows

$$y_t = [OP, EX, GR, GE\_C, GE\_I, GDP]'$$

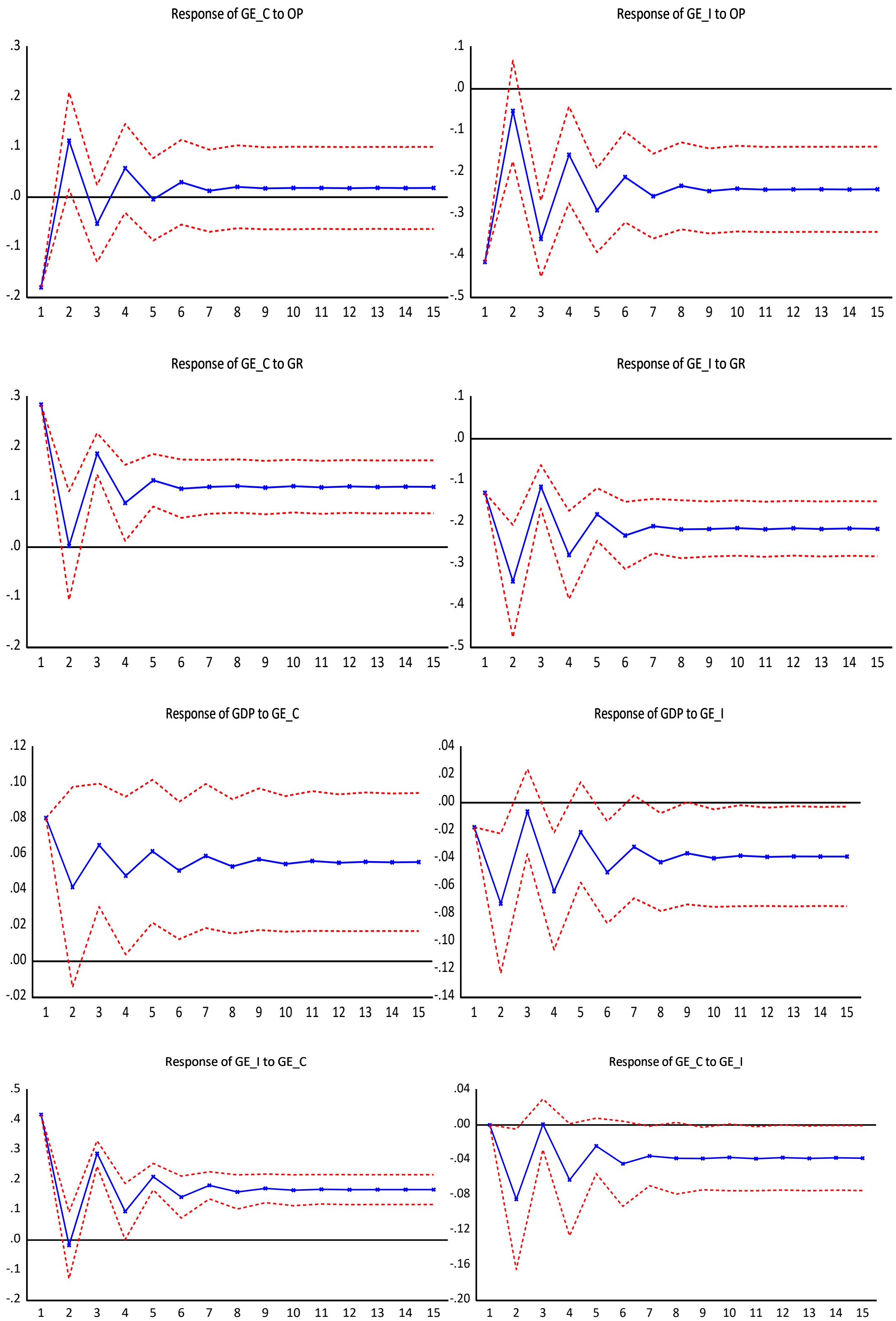
We follow the same order as Dizaji (2014) and the discussion of Farzanegan (2011) for the Iranian economy. In comparison, Eltony and Al-Awadi (2001) started with investment government expenditure for the Kuwaiti economy. Figure 2.14 shows the impact of oil price shocks on the current government expenditure, it fluctuates within the first six quarters and then stabilises, while it responds positively and significantly to the government revenue. Similarly, the oil price shock does not have much impact on the current government expenditure on the Kuwaiti economy. We could attribute this to the use of the capital reserve to finance current spending commitments (Eltony & Al-Awadi, 2001).

In contrast, investment government expenditure responds negatively and significantly to both oil price and government revenue shocks, indicating that the Omani government adopts a countercyclical policy. This appears to be consistent with Frankel et al. (2013) who analysed the fiscal policy in 94 developed and developing countries including Oman. Their results show that the fiscal policy in Oman was procyclical between 1960 and 1999 while it turned to be countercyclical between 2000 and 2009 (Frankel et al., 2013).[23] Dizaji (2014), on the other hand, found there is a positive and significant impact of government revenue on both current and investment expenditure for the Iranian economy compared to the non-significant impact of oil revenue.

GDP responds positively to the current expenditure, while it responds negatively to the investment expenditure, but the results are only marginally significant. In terms of the relationship between the two subcomponents, investment expenditure responds positively and significantly to the current expenditure; however, current expenditure responds negatively and marginally significantly to investment expenditure. This indicates that an increase in investment spending has a negative impact on the current expenditure. Nevertheless, investment expenditure does not have a long-run impact on the GDP because it only accounts for less than one-third of the government spending.

[23] Using the correlation between the cyclical components of real government expenditure and real GDP.

Figure 2.14. Model specification with current government expenditure and investment government expenditure



2.5.2.3 Petroleum GDP versus non-petroleum GDP

Gross domestic product in Oman is divided into petroleum GDP (GDP_P) and non-petroleum GDP (GDP_NP). This specification aims to examine the responses of GDP subcomponents to the oil price, government revenue, and government expenditure as Figure 2.15 shows.

$$y_t = [OP, EX, GR, GE, GDP\_P]'$$

Or

$$y_t = [OP, EX, GR, GE, GDP\_NP]'$$

As expected, petroleum GDP responds strongly to the oil price shock. Similarly, non-petroleum GDP responds positively and statistically significant to oil price shock; it may be due to the impact of the petrochemical industry and government investment in non-petroleum GDP. Turning to examine the impact of two fiscal policy shocks: government revenue and government expenditure. Petroleum GDP does not respond to government revenue or government expenditure, given that oil prices are exogenously determined. It is not surprising to note that the petroleum GDP (GDP_P) is non-responsive to the government expenditure (GE). It is mainly influenced by the global oil price movements which are driven by the global demand and supply conditions, rather than by any domestic driven factors. Compared to that, non-petroleum GDP responds positively and statistically significant to both government revenue and government expenditure. So, the fiscal policy variables have an impact on non-petroleum GDP while it has no impact on petroleum GDP.

2.5.3 The model with oil price volatility

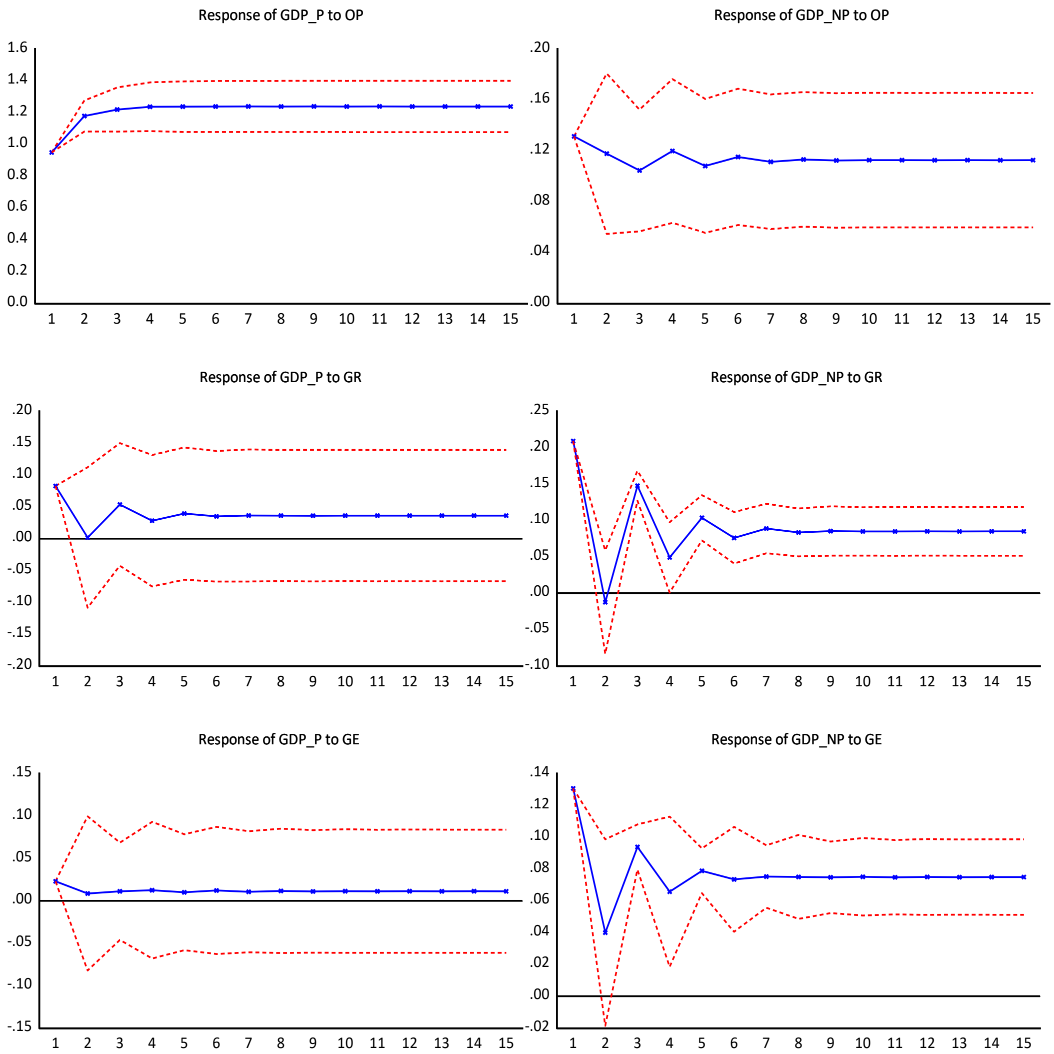
Oil price volatility (OPV) is the degree of variation of oil price series over time, will be measured by the standard deviation of each three months of the oil price.[24] This captures the concern over the effects of increasing oil price volatility in the last two decades (Baumeister & Peersman, 2013). Moreover, oil price volatility has an impact on the fiscal and external balances in oil-exporting countries due to higher interest burdens, revaluation of foreign debt and financial sector stresses (IMF, 2019). Further, commodity price volatilities are considered as a channel for resource curse, causing economic uncertainty and delays in budget stability (Majumder et al., 2020).

Having discussed the impact of oil price shock, the goal of this model specification is to examine the impact of oil price volatility on the macroeconomic variables ordered as follow,

$$y_t = [OPV, EX, GR, GE, IN, GDP]'$$

[24] Aghion et al. (2009) use standard deviation to calculate exchange rate volatility, Arezki et al. (2014) used it to calculate exchange rate volatility and gold price volatility and Mondal and Khanam (2018) apply it to calculate household consumption volatility.

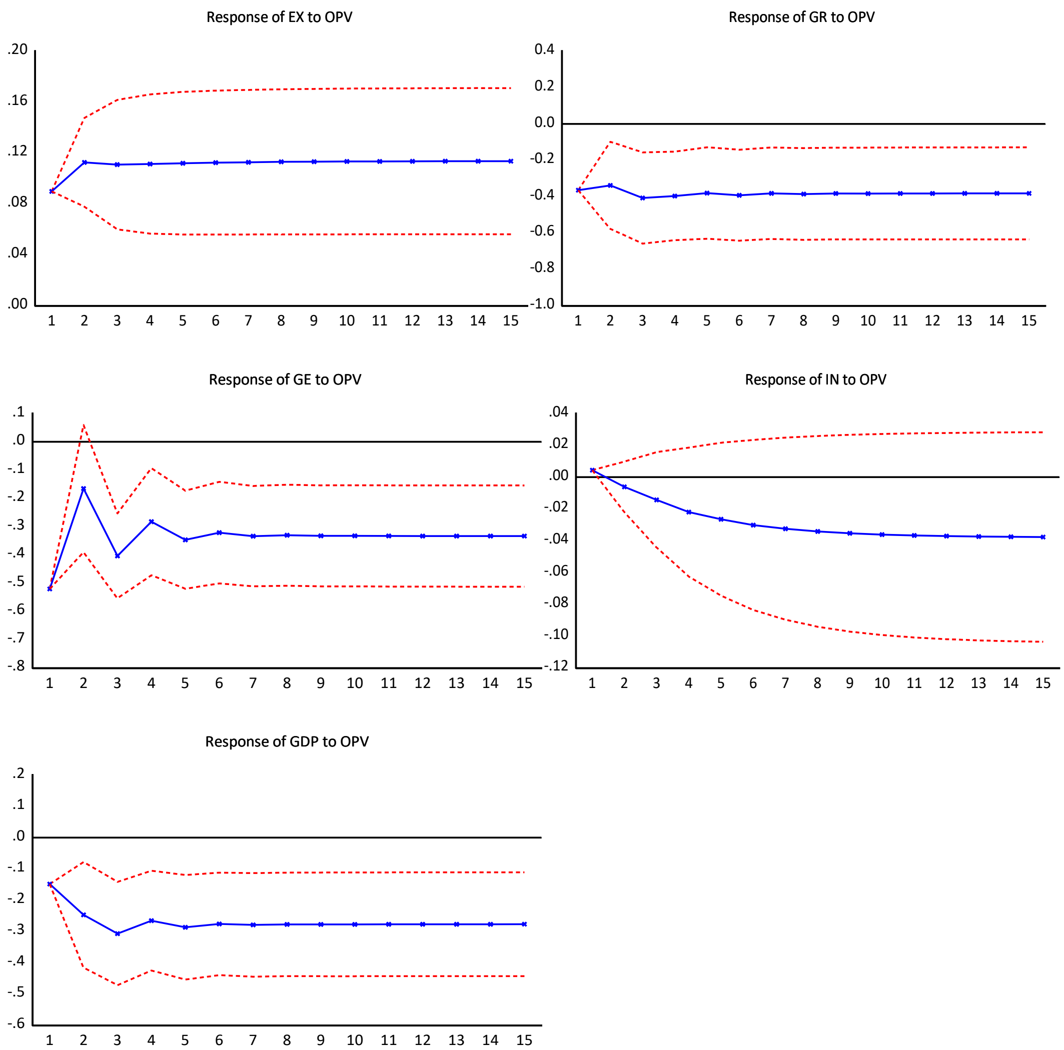
Figure 2.15. Model specification with petroleum GDP or non-petroleum GDP



The outcome of this model specification is as expected in terms of the impact on the government revenue, government expenditure, and GDP and their specification compared to the baseline model with the oil price.

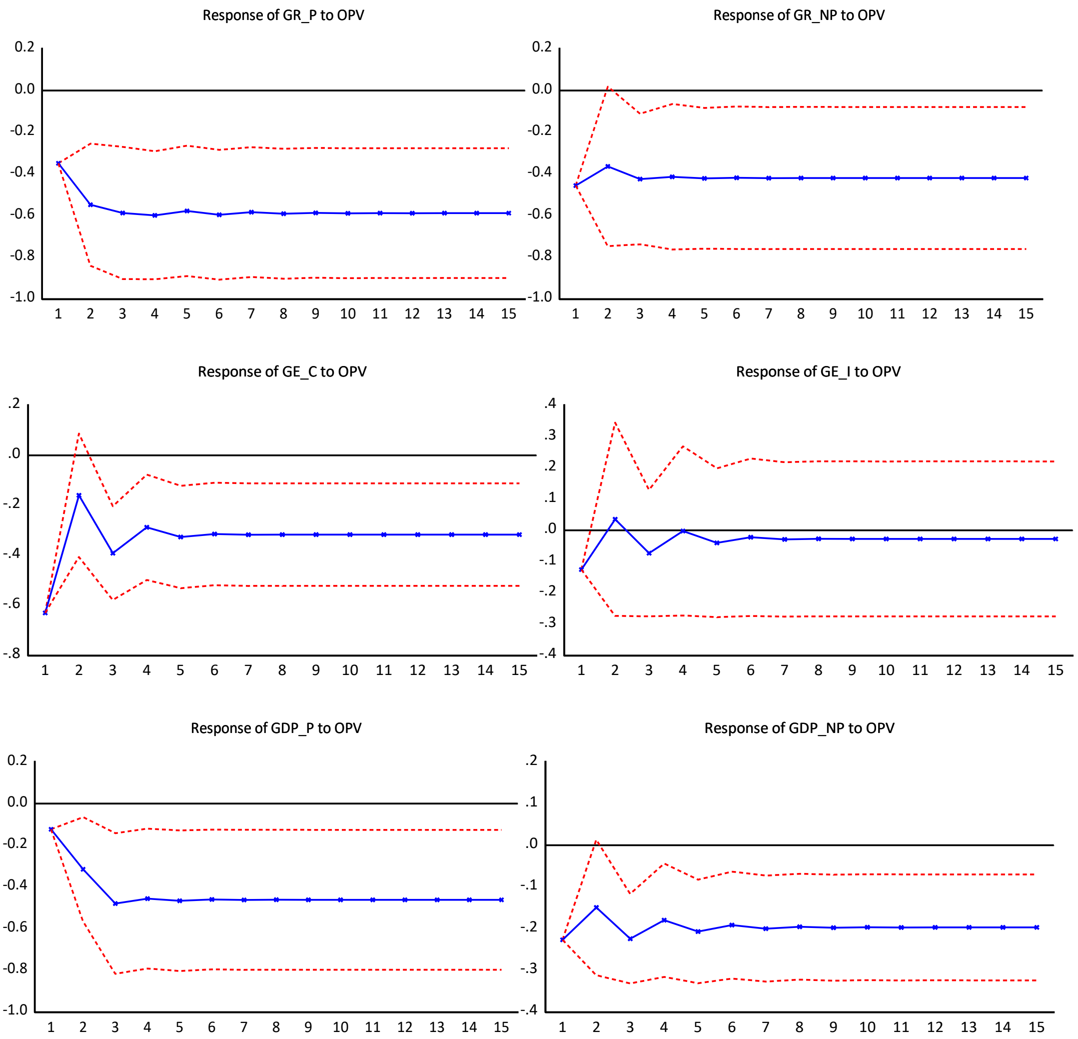
The impulse response results in Figure 2.16 show that the exchange rate responds positively and statistically significant to the oil price volatility shocks as it reacts to an oil price shock. Likewise, Englama et al. (2010) found a positive relationship between oil price volatility and exchange rate volatility for Nigeria. For the policy variables, while the government revenue responds positively to the oil price shock, it responds negatively to oil price volatility shock. On the other hand, government expenditure does not respond to the oil price shock, but it responds negatively and significantly to the oil price volatility shocks. Compared to that, using a GMM dynamic panel, El Anshasy and Bradley (2012) found that government expenditure decreases as the oil price volatility increases. The GDP responds negatively to the oil price volatility while it responds positively to the oil price shock. As observed for oil price shock, oil price volatility also has no impact on inflation.

Figure 2.16. Accumulative response to oil price volatility shock



Next, we include the oil price volatility in the different model specifications as shown in Figure 2.17. Petroleum government revenue responds negatively and statistically significant to the oil price volatility shocks, while it responds positively to the oil price shock. In Comparison, non-petroleum revenue responds negatively to oil price volatility, while it does not respond to oil price shock. Although the current government expenditure responds negatively to the oil price volatility shock, government investment expenditure does not respond to the oil price volatility. This may be explained by the fact that investment decisions are made for the long term; therefore, the government is involved in contracts and legal obligations and acts to see through the volatility in making its decisions. In addition, as shown in Figure 2.6 the investment government spending fluctuates less compared to the current spending. Oil price volatility has a negative and significant impact on both petroleum-GDP and non-petroleum GDP.

Figure 2.17. Accumulative response to oil price volatility shock in different model specifications



2.5.4 Forecast error variance decomposition

This section presents the result of forecast error variance decompositions (FEVD) for the baseline model and for different model specifications. It shows the percentage that each shock in the model contributes to the predicted error variance for a specific variable within a specific time horizon.

2.5.4.1 Baseline model

The forecast error variance decomposition for the baseline is presented in Table 2.3. The results reveal that oil price shocks play a key role in explaining the variance in government revenue and GDP. It explains 18.65% of variance decomposition for the former and 55.22% for the latter in the 1st quarter. This percentage increased to 22.02% for government revenue while it decreases to 45.62% for the GDP in the 5th quarter and persists until the 15th quarter. Compared to that, besides its own shock, two variables contribute to the variance of government expenditure: oil price and government revenue. Oil price shock contributes by 5.51% in the 1st quarter then increased to 14.03% in the 10th, and government revenue contributes by 3.54% in the 1st quarter increased to 7.41% in the 10th. In contrast, more than 90% of the variances in the exchange rate and inflation are caused by their own shocks. A government revenue shock explains 4.45% of the GDP's variance in the 1st quarter and increases to 10.63% in the 5th quarter. In contrast, the contribution of government expenditure is lower to the GDP's variances, only 1.57% in the 1st quarter and increased to 1.72% in 5th, 10th, and 15th.

Table 2.3. Forecast error variance decomposition for the baseline model

Variable	Horizon (quarters)	Source of Disturbance					
		OP	EX	GR	GE	IN	GDP
EX	1	0.03	99.97	0.00	0.00	0.00	0.00
	5	3.54	95.69	0.19	0.20	0.03	0.35
	10	3.54	95.68	0.19	0.20	0.03	0.35
	15	3.54	95.68	0.19	0.20	0.03	0.35
GR	1	18.65	0.34	81.01	0.00	0.00	0.00
	5	22.02	0.34	75.14	0.97	0.71	0.81
	10	22.01	0.34	75.08	1.01	0.74	0.81
	15	22.01	0.34	75.08	1.01	0.74	0.81
GE	1	5.51	0.47	3.54	90.48	0.00	0.00
	5	13.98	0.39	7.45	75.13	0.18	2.87
	10	14.03	0.39	7.41	74.77	0.20	3.20
	15	14.03	0.39	7.41	74.77	0.20	3.20
IN	1	0.93	0.30	0.14	5.83	92.79	0.00
	5	0.67	0.74	0.16	4.34	94.04	0.05
	10	0.67	0.76	0.16	4.30	94.06	0.05
	15	0.67	0.76	0.16	4.29	94.06	0.05
GDP	1	55.22	0.02	4.45	1.57	0.47	38.26
	5	45.62	0.24	10.63	1.72	1.80	39.99
	10	45.58	0.24	10.68	1.72	1.83	39.95
	15	45.58	0.24	10.68	1.72	1.83	39.95

2.5.4.2 Different model specifications

We now consider the forecast error variance decomposition for the model with different specifications.

2.5.4.2.1 Petroleum government revenue versus non-petroleum government revenue

Tables 2.4 and 2.5 show the results for forecast error variance decomposition for the model with petroleum government revenue or with non-petroleum revenue. As expected, the contribution of oil price shock on the variance of petroleum government revenue is higher compared to the total government revenue. Oil price shocks explain 22.14% in the 1st quarter then increases to 25.63% in the 10th quarter of the petroleum government revenue variance. Compared to that, on average oil price shock contributes only 1% of the variance of non-petroleum government revenue. In terms of the impact of the two government revenue specifications on government expenditure, there is an interesting outcome. Non-petroleum government revenue explains a high percentage of the government expenditure variance compared to petroleum government revenue. About 11.67% of the variance decomposition for government expenditure is attributed to non-petroleum government revenue compared to only 4.27% for the petroleum government revenue in the 5th quarter. Referring to Figures 2.12 and 2.13, government expenditure responds more to the non-petroleum government revenue compared to petroleum revenue. Turning to the GDP, petroleum government revenue explains between 4.34% in the 1st quarter and 6.63% in the 5th quarter of GDP's variances. Compared to that, non-petroleum revenue explains close to 0% in the 1st quarter and only increased to 1.46% in the 5th quarter.

Table 2.4. Forecast error variance decomposition for model specification with petroleum government revenue.

Variable	Horizon (quarters)	Source of Disturbance				
		OP	EX	GR_P	GE	GDP
GR_P	1	22.14	1.21	76.66	0.00	0.00
	5	25.64	0.98	71.12	1.55	0.72
	10	25.63	0.98	71.04	1.63	0.72
	15	25.63	0.98	71.04	1.63	0.72
GE	1	5.51	0.65	1.47	92.37	0.00
	5	14.74	0.56	4.27	77.95	2.48
	10	14.83	0.56	4.28	77.49	2.84
	15	14.83	0.56	4.28	77.49	2.84
GDP	1	53.17	0.03	4.34	2.05	40.41
	5	44.93	0.16	6.63	3.04	45.24
	10	44.89	0.16	6.67	3.05	45.23
	15	44.89	0.16	6.67	3.05	45.23

2.5.4.2.2 Current and investment government expenditure

Table 2.6 shows oil price shocks explain a higher proportion of the variance of the government investment expenditure (GE_I) compared to government revenue shocks. In the 5th quarter, 17.11% of the investment expenditure is explained by oil price shock compared to only 3.72% by government revenue. This stems from the fact that the investment expenditure is planned based on the long-term development plans centred on the anticipated future oil prices. In contrast, both oil price and government revenue contributed almost equally to the variance of current government expenditure (GE_C), i.e. 10.98% for the former, and 9.25% for the latter in the 5th quarter. For the impact of the two expenditure components on the GDP, in the 5th quarter, current expenditure contributes only 1.57% only, while investment expenditure contributes by 2.97% to the GDP's variance.

Table 2.5. Forecast error variance decomposition for model specification with non-petroleum government revenue.

Variable	Horizon (quarters)	Source of Disturbance				
		OP	EX	GR_NP	GE	GDP
GR_NP	1	0.89	1.14	97.96	0.00	0.00
	5	1.01	1.42	97.41	0.01	0.14
	10	1.02	1.42	97.40	0.01	0.14
	15	1.02	1.42	97.40	0.01	0.14
GE	1	4.48	0.32	10.53	84.67	0.00
	5	11.89	0.26	11.67	74.68	1.50
	10	11.96	0.27	11.64	74.44	1.69
	15	11.96	0.27	11.64	74.44	1.69
GDP	1	53.89	0.11	0.00	3.08	42.91
	5	45.73	0.39	1.46	3.76	48.65
	10	45.67	0.39	1.51	3.77	48.65
	15	45.67	0.39	1.51	3.77	48.65

Table 2.6. Forecast error variance decomposition for model specifications with current and investment government expenditure

Variable	Horizon (quarters)	Source of disturbance					
		OP	EX	GR	GE_C	GE_I	GDP
GE_C	1	3.43	1.14	5.67	89.76	0.00	0.00
	5	10.98	0.86	9.25	75.04	1.53	2.34
	10	11.03	0.86	9.22	74.75	1.56	2.57
	15	11.03	0.86	9.23	74.75	1.56	2.57
GE_I	1	11.81	0.01	0.76	10.21	77.20	0.00
	5	17.11	0.56	3.72	16.26	60.27	2.07
	10	17.23	0.57	3.75	16.26	59.70	2.49
	15	17.23	0.57	3.75	16.26	59.70	2.49
GDP	1	52.67	0.13	4.83	1.47	0.09	40.81
	5	43.42	0.32	10.93	1.57	2.97	40.79
	10	43.28	0.32	11.03	1.60	3.26	40.50
	15	43.28	0.32	11.03	1.60	3.26	40.50

2.5.4.2.3 Petroleum GDP or non-petroleum GDP

The oil price shock explains a high percentage of petroleum GDP disturbances as reported in Table 2.7, i.e. 91.51% in the 1st quarter, and 90.08% in the 5th quarter. However, oil price shocks explain only 4.20% in 1st and 3.00% in the 5th quarter of the non-petroleum GDP variances. In terms of the impact of fiscal policy variables; government revenue and government spending, they contribute by a negligible percentage of the petroleum GDP's variance. In contrast, government revenue explains 7.21% and government expenditure explains 2.89% of the non-petroleum GDP in the 1st quarter. In the 5th it increased to 14.80% for the former and 3.38% for the latter.

Table 2.7. Forecast error variance decomposition for model specifications with petroleum GDP and non-petroleum GDP

Variable	Horizon (quarters)	Source of disturbance					
		OP	EX	GR	GE	GDP_P	GDP_NP
GDP_P	1	91.51	0.02	0.48	0.04	7.95	-
	5	90.08	0.44	1.10	0.05	8.33	-
	10	90.08	0.44	1.10	0.05	8.33	-
	15	90.08	0.44	1.10	0.05	8.33	-
GDP_NP	1	4.20	0.00	7.21	2.89	-	85.70
	5	3.00	0.02	14.80	3.38	-	78.80
	10	3.01	0.02	14.89	3.38	-	78.70
	15	3.01	0.02	14.89	3.38	-	78.70

2.5.5 Model specification with oil price volatility

In this subsection, the oil price will be replaced by oil price volatility (OPV) in the baseline model as in the different model specifications, to examine the impact of oil price volatility on the other macroeconomic variables.

2.5.5.1 Baseline model

Table 2.8 illustrates the forecast error variance decomposition for the baseline model. The oil price volatility shocks explain less of the variance in government revenue, government expenditure, and GDP compared to oil price shocks. Oil price volatility explains 2.05% of the government revenue, 5.82% for the government expenditure, and 1.12% for GDP in the 5th quarter.

2.5.5.2 Different specification for the model

This model specification with petroleum or non-petroleum revenue, most of the disturbances in petroleum revenue and non-petroleum revenue are attributed to themselves and the contribution of oil price volatility is small. Moreover, the percentage of contribution to the two variables is almost equal, around 1.00% as Table 2.9 shows.

Shifting now to the model specification with two expenditure subcomponents, the results are shown in Table 2.10 below. Oil price volatility contributes more to current government expenditure variance than to investment expenditure variance, i.e. 7.90% for the former, and only 0.66% for the latter in the 5th quarter. Compared to that, an oil price shock contributes higher to the investment expenditure variances (17.11%) than for current expenditure (10.98%) in the 5th quarter.

Moving on, we decompose the GDP to petroleum and non-petroleum. The results in Table 2.11 shows oil price volatility shocks explain a small percentage of the disturbance in both variables. Surprisingly, it explains slightly more of the non-petroleum GDP variance compared to petroleum GDP.

Table 2.8. Forecast error variance decomposition for the baseline model

Variable	Horizon (quarters)	Source of Disturbance					
		OPV	EX	GR	GE	IN	GDP
EX	1	6.50	93.50	0.00	0.00	0.00	0.00
	5	6.26	89.12	1.67	0.56	0.21	2.18
	10	6.26	89.10	1.67	0.56	0.23	2.18
	15	6.26	89.10	1.67	0.56	0.23	2.18
GR	1	2.28	0.01	97.71	0.00	0.00	0.00
	5	2.05	0.74	87.92	0.27	0.17	8.84
	10	2.06	0.74	87.85	0.32	0.18	8.84
	15	2.06	0.74	87.85	0.32	0.18	8.84
GE	1	5.28	1.90	0.54	92.28	0.00	0.00
	5	5.82	1.24	0.44	86.51	0.23	5.77
	10	5.82	1.24	0.44	86.44	0.24	5.83
	15	5.82	1.24	0.44	86.44	0.24	5.83
IN	1	0.08	0.34	0.24	4.17	95.18	0.00
	5	0.57	0.30	0.15	3.28	95.21	0.49
	10	0.60	0.30	0.15	3.25	95.20	0.50
	15	0.61	0.30	0.15	3.25	95.20	0.50
GDP	1	0.76	0.05	30.30	0.02	0.01	68.85
	5	1.12	1.66	31.19	3.22	0.10	62.70
	10	1.13	1.66	31.17	3.23	0.11	62.70
	15	1.13	1.66	31.17	3.23	0.11	62.70

Table 2.9. Forecast error variance decomposition for model specifications with petroleum government revenue or non-petroleum government revenue

Variable	Horizon (quarters)	Source of disturbance					
		OPV	EX	GR_P	GR_NP	GE	GDP
GR_P	1	1.37	0.45	98.18	-	0.00	0.00
	5	1.56	1.30	86.65	-	0.40	10.08
	10	1.57	1.30	86.56	-	0.49	10.08
	15	1.57	1.30	86.56	-	0.49	10.08
GR_NP	1	1.36	1.94	-	96.70	0.00	0.00
	5	1.18	2.38	-	96.37	0.00	0.07
	10	1.18	2.38	-	96.37	0.00	0.07
	15	1.18	2.38	-	96.37	0.00	0.07

Table 2.10. Forecast error variance decomposition for model specification with current government expenditure and investment government expenditure

Variable	Horizon (quarters)	Source of disturbance					
		OPV	EX	GR	GE_C	GE_I	GDP
GE_C	1	6.54	3.32	1.64	88.50	0.00	0.00
	5	7.90	2.49	1.41	82.91	1.04	4.24
	10	7.90	2.49	1.41	82.88	1.06	4.26
	15	7.90	2.49	1.41	82.88	1.06	4.26
GE_I	1	0.01	0.00	3.51	14.97	81.51	0.00
	5	0.66	0.05	2.24	25.27	67.63	4.15
	10	0.67	0.05	2.24	25.28	67.50	4.25
	15	0.67	0.05	2.24	25.28	67.50	4.25

Table 2.11. Forecast error variance decomposition for model specification with petroleum GDP and non-petroleum GDP

Variable	Horizon (quarters)	Source of Disturbance					
		OPV	EX	GR	GE	GDP_P	GDP_NP
GDP_P	1	0.23	0.00	23.12	3.26	73.38	-
	5	1.11	3.15	21.44	5.58	68.73	-
	10	1.11	3.15	21.44	5.58	68.73	-
	15	1.11	3.15	21.44	5.58	68.73	-
GDP_NP	1	1.87	0.16	10.76	1.55	-	85.65
	5	1.63	1.04	16.29	3.22	-	77.82
	10	1.63	1.04	16.30	3.31	-	77.72
	15	1.63	1.04	16.30	3.31	-	77.72

2.5.6 Historical decomposition

This section presents historical decomposition for the three main variables in the model, namely GDP, government revenue, and government expenditure. The historical decomposition quantifies the importance of different shocks on a variable. Figure 2.18 shows GDP as mostly affected by its own shocks and the oil price shock, particularly in 1997-1998, 2008-2009, and recently in 2014-2016. Considering the historical decomposition of government revenue and government expenditure. Figure 2.19 shows that oil price contributes substantially to the government revenue and compared to that, Figure 2.20 illustrates government expenditure decomposition attributes by its own shock mainly. Comparing the impacts of the oil price fall in three different periods: Asian Financial crisis, Global Financial Crisis, and the recent fall in oil prices 2014-2016. It is clear that the impact of the 1998 Asian Crisis and recent fall is higher compared to the impact of the 2008 Global Crisis as Asia is the main export destination for Omani crude oil. In addition, the impact of the recent fall on the GDP and government revenue is high compared to the previous two events because of an increase in the supply of shale oil, and increased production from Russia, and Saudi Arabia.

Figure 2.18. Historical decomposition for GDP

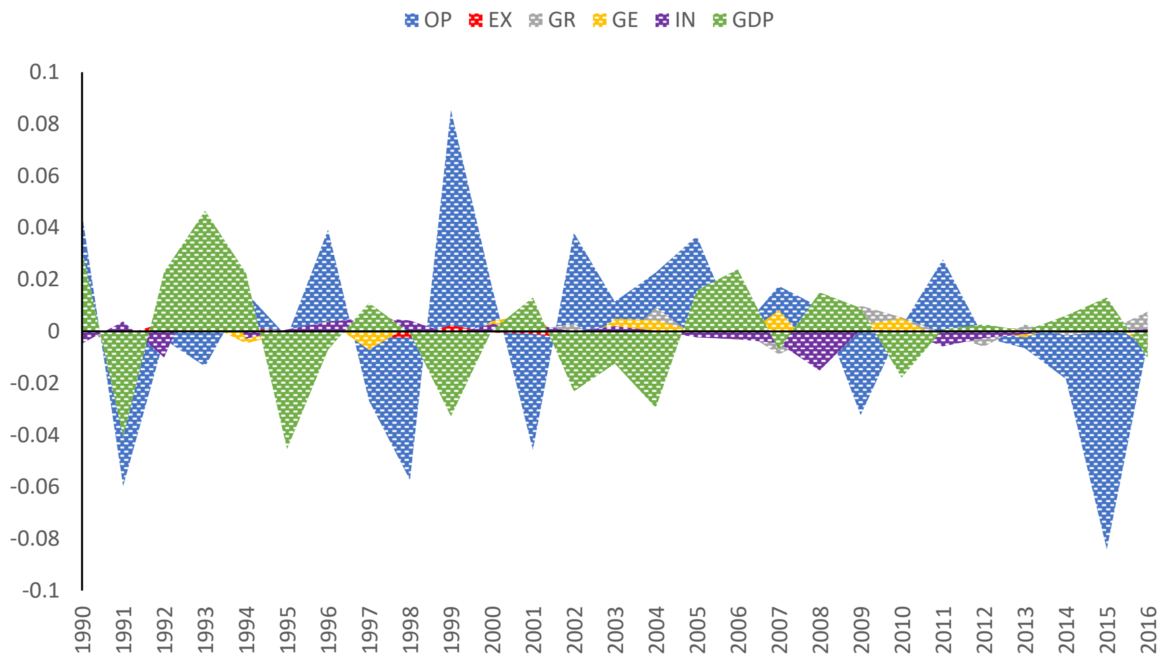


Figure 2.19. Historical decomposition for government revenue

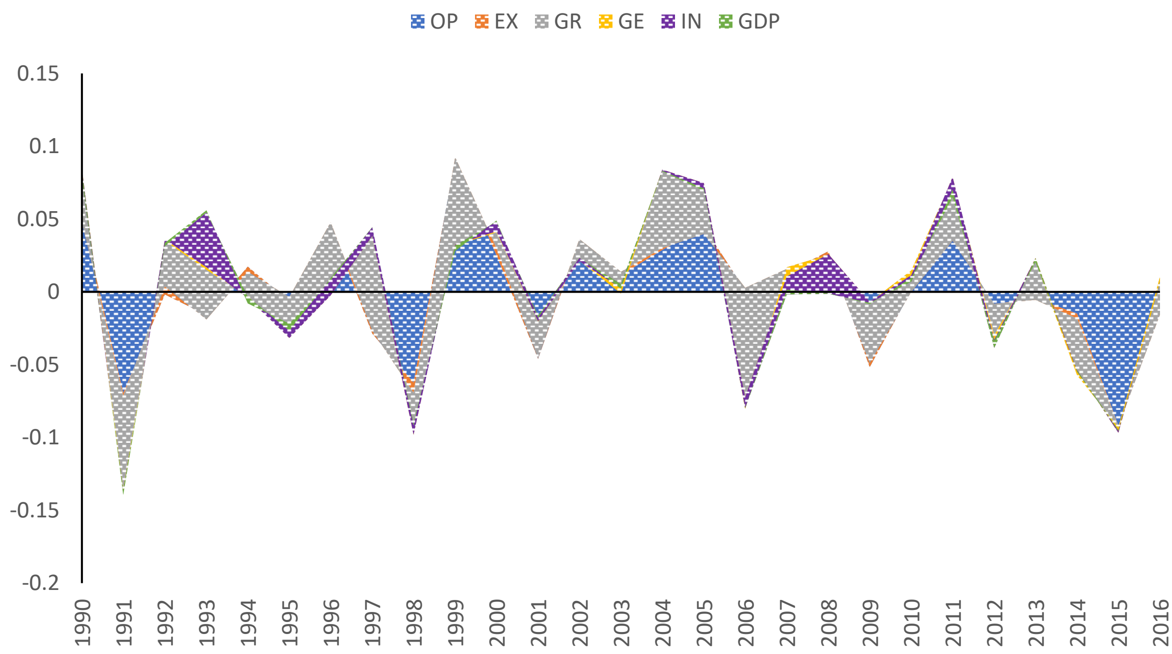
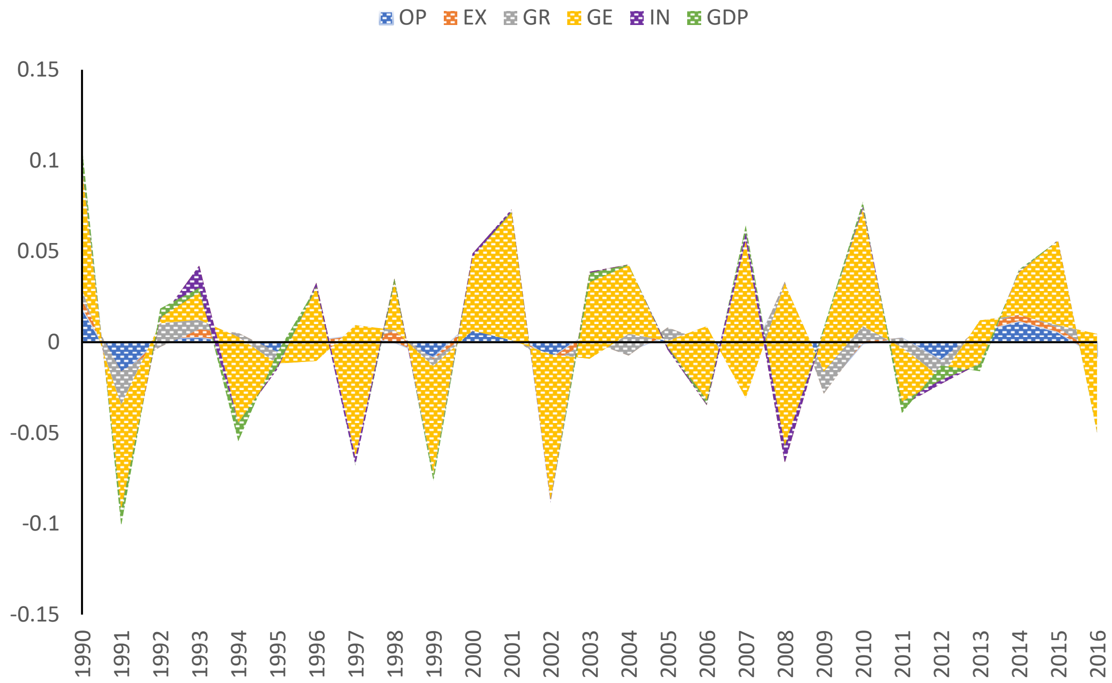


Figure 2.20. Historical decomposition for government expenditure



2.6 Conclusion and policy implication

The Omani economy is an oil-dependent economy. The petroleum sector has contributed up to 80% of the government's revenue, 60% of export value, and 40% of GDP (NCSI, 2017). This study aims to study the impacts of the oil price shocks on the Omani economy and its fiscal measures.

The study provides a comprehensive analysis of an oil-dependent economy, which can be used as a guide for policy, targeted not only for the Omani economy but also for other similar economies, particularly in the Middle East. We expand the analysis, using different model specifications of the subcomponents of the government revenue, government expenditure, GDP, and replace oil price by the oil price volatility.

The results of the impulse responses show that oil price shocks have a positive impact on the exchange rate, government revenue, and GDP. Interestingly, the impact of oil price shock on the government expenditure is weak and insignificant, although it responds positively to a government revenue shock. The high portion of salaries in government spending, establishment of the saving fund, and using it along with local and international debt to smooth the government spending are possible reasons to explain this weak response. On the other hand, as expected, government revenue, government expenditure, and GDP respond negatively and statistically significant when replacing the oil price with oil price volatility.

Turning to the model specifications, the petroleum components of GDP and government revenue respond more to oil price shocks compared with the non-petroleum related components. In addition, the oil price has an impact on the non-petroleum GDP, possibly through the petrochemicals industry and government spending. Surprisingly, the investment government expenditure responds negatively to the oil price and government revenue shocks. This may be caused by changes in the fiscal policy in Oman from procyclical to countercyclical between 2000 and 2009. It may also be an indicator that the amount allocated for government investment expenditure is not sufficient to create long-term sustainable gain because the GDP responds negatively to the investment government expenditure which can also be associated with crowding-out effects. This needs more investigations. Oil price volatility has no impact on investment spending, which can be associated with the long-term nature of the investment expenditure plan.

The results of forecast error variance decompositions support the results from impulse response. Oil price shocks explain more of the variation in the petroleum-related components compared to non-petroleum. The highest is in case of petroleum GDP; oil price shock explains 91.51% of the variance in petroleum GDP in the 1st quarter and 90.08% in the 5th, 10th, and 15th quarters. In contrast, oil price volatility shock has less ability to explain the variation in government revenue, government expenditure, and GDP and their respective subcomponents.

The historical decomposition for GDP, government revenue, and government expenditure also show that oil price has more impact on GDP and government revenue compared to government expenditure.

The oil price shock has no impact on government expenditure which indicates the ability to smooth the spending using saving fund and domestic and international debt. Moreover, since a high percentage of government spending is a current expenditure, this causes difficulties for the government to decrease the spending in response to negative oil price shocks. Although, the government included reduction of fiscal spending as one of the three goals of the 2017 general budget along with enhancing non-petroleum revenue and pursuing economic diversification (CBO, 2017) the current government expenditure could increase due to social and political reasons.

The fiscal policy in oil-exporting countries uses public sector employment, higher wage, and social welfare as a tool to share the oil wealth (Chemingui & Roe, 2008). Although, these are good approaches to distribute the oil rent, managing large size government in oil-exporting countries can be a challenge, particularly when oil price declines. Falls in oil prices can be associated with gradual increases in the fiscal breakeven price, which leads to the budget deficit, high debt, and depletion of reserve funds. These outcomes have a negative impact on the economic legacy for future generations unless the government control its spending, and prudently manages the public debt. Currently, the investment is only less than one-third of the total government spending, which is not adequate in the long run to create sustainable growth.

Oil is an exhaustible and volatile source of government revenue, and the Omani government is planning to apply the value-added tax (VAT) in 2021. As a result of the recent oil plunge, there is increasing interest from GCC countries to adopt the VAT to increase non-oil revenue. [25] But as expected, people in Oman are not welcoming the VAT, as they fear it may affect their welfare and prosperity, especially for the low-income earners. Another possible policy the government may consider is to enforce ‘Azakah’, a compulsory levy imposed on the Muslims to take surplus money or wealth from the comparatively well-to-do members of the Muslim society and give it to the poorer members of the society. This approach might be more receptive, as it economically helps to improve the poor’s purchasing power, and drive to a higher demand for goods and services.

[25] Economic diversification in oil-exporting Arab countries, prepared by staff of the IMF, annual meeting of Arab Ministries of Finance, April 2016, Manama, Bahrain.

2.7 Appendix

Appendix 2.A: Summary of empirical studies on the impact of oil price shock on the macroeconomic variables in oil-exporter economies

The study	Aim and Methodology	Country
Eltony and Al-Awadi (2001)	- Study the impact of oil price shock on the macroeconomic variables. - Applied VAR and VECM models. - The variables used: oil price, oil revenue, government development expenditure, government current expenditure, inflation, money demand, and value of imported goods and services.	Kuwait
Olomola and Adejumo (2006)	- Study the impact effect of oil price shock on the macroeconomic variables. - Applied VAR model. - The variables used: Industrial production index, consumer price index, exchange rate, domestic wholesale price index, and oil price.	Nigeria
Mehrara and Oskoui (2007)	- Study the source of macroeconomic fluctuations in oil exporting countries. - Applied SVAR model. - The variables used: oil price, industrial output, exchange rate, consumer price index.	Iran, Indonesia, Kuwait, Saudi
Farzanegan and Markwardt (2009)	- Study the dynamic relationship between oil price shock and macroeconomic variables. - Applied VAR model. - The variables used: oil price, government expenditure, industry GDP per capita, inflation, exchange rate, import.	Iran
Al-Saqri (2010)	- Study the long-run relationship between GDP, government revenue, exchange rate and oil price. - Applied VECM model. - The variables used: GDP, government revenue, exchange rate and oil price.	Oman
Berument et al. (2010)	- Study the effect of oil price shocks on exchange rate, inflation and output. - Applied SVAR model. - The variables used: oil price, exchange rate, inflation and GDP.	16 MENA countries
Farzanegan (2011)	- Study the dynamic impact of oil revenue on the government expenditure categories. - Applied VAR model. - The variables used: oil export revenue per capita, government health expenditure, government military expenditure, government security expenditure, government education expenditure, government culture expenditure.	Iran
Bouchaour and Al-Zeaud (2012)	- Study the impact of oil price fluctuations on the macroeconomy. - Applied VECM model. - The variables used: GDP, unemployment rates, inflation, exchange rate and money supply.	Algeria
Emami and Adibpour (2012)	- Study the impact of oil revenue shocks on the output. - Applied SVAR model. - The variables used: GDP, government expenditure, liquidity, exchange rate, positive oil revenue and negative oil revenue.	Iran
Esfahani et al. (2013)	- Study the long run impact of the oil export on the economy. - Applied vector error-correcting model (VECX*) model. - The variables used: real output, real money balance, inflation, exchange rate, oil export, and foreign real output.	Iran
Hamdi and Sbia (2013)	- Study empirically the dynamic relationships between oil revenue, government spending and economic growth. - Applied VECM model. - The variables used: oil revenue, government spending and GDP.	Bahrain
Dizaji (2014)	- Study the relationship between the government revenue and government expenditure. - Applied SVAR model. - The variables used: oil prices, ratio of oil revenues to GDP, and ratio of government total expenditures to GDP.	Iran

Pazouki and Pazouki (2014)	-	Study the impact of oil price shocks on the government spending. - Applied VAR model. - The variables used: oil price and four different government expenditure (social security, education, health, culture).	Iran
Masan (2016)	-	Study the dynamics relationship between GDP, oil revenue and government expenditure. - Applied VECM model. - The variables used: GDP, oil revenue, and government expenditure.	Oman
Alawadhi et al. (2018)	-	To study the impact of global shock on the Kuwait economy. - Applied GVAR model. - The variables used: GDP, inflation rate, short-term interest rate, long-term interest rate, exchange rate and equity prices.	Kuwait

Appendix 2.B: The data source is the monthly statistical bulletin, retrieved from NCSI website: (https://www.ncsi.gov.om/Elibrary/Pages/LibraryContentView.aspx)

The variables	Abbreviation	Source	Frequency	Measure
Gross Domestic Products	GDP	Table (2): Gross Domestic Products	Quarterly	Constant, seasonally adjusted, log
Petroleum Gross Domestic Products	GDP_P	Table (2): Gross Domestic Products	Quarterly	Constant, seasonally adjusted, log
Non-Petroleum Gross Domestic Products	GDP_NP	Table (2): Gross Domestic Products	Quarterly	Constant, seasonally adjusted, log
Government Revenue	GR	Table (3): Public Finance	Monthly	Constant, seasonally adjusted, log
Petroleum Government Revenue	GR_P	Table (3): Public Finance	Monthly	Constant, seasonally adjusted, log
Non-Petroleum Government Revenue	GR_NP	Table (3): Public Finance	Monthly	Constant, seasonally adjusted, log
Government Expenditure	GE	Table (3): Public Finance	Monthly	Constant, seasonally adjusted, log
Current Government Expenditure	GE_C	Table (3): Public Finance	Monthly	Constant, seasonally adjusted, log
Investment Government Expenditure	GE_I	Table (3): Public Finance	Monthly	Constant, seasonally adjusted, log
Oil Price	OP	Table (7): Crude oil and gas sector	Monthly	Constant, seasonally adjusted, log
Effective Exchange Rate Index	EX	Table (9): Money and banking	Monthly	Seasonally adjusted, log
Consumer Price Index	IN	Consumer Price Index	Quarterly	Seasonally adjusted, log

Appendix 2.C: Unit root results for the variables in logarithmic difference

Variable	level						1st diff					
	ADF		PP		KPSS		ADF		PP		KPSS	
GDP	-3.47	I(0)	-3.28	I(1)	0.13	I(0)	-13.41	I(0)	-16.72	I(0)	0.17	I(0)
GDP_P	-2.43	I(1)	-2.08	I(1)	0.14	I(0)	-9.37	I(0)	-9.52	I(0)	0.11	I(0)
GDP_NP	-3.87	I(1)*	-7.52	I(0)	0.09	I(0)	-18.63	I(0)	-74.59	I(0)	0.11	I(0)
GR	-2.83	I(1)	-2.83	I(1)	0.12	I(0)	-12.62	I(0)	-12.87	I(0)	0.09	I(0)
GR_P	-2.77	I(1)	-2.64	I(1)	0.11	I(0)	-12.50	I(0)	-12.77	I(0)	0.09	I(0)
GR_NP	-3.45	I(0)	-9.12	I(0)	0.20	I(1)	-12.12	I(0)	-36.18	I(0)	0.09	I(0)
GE	-2.76	I(1)	-8.45	I(0)	0.24	I(1)	-9.26	I(0)	-49.18	I(0)	0.10	I(0)
GE_C	-3.19	I(1)	-8.91	I(0)	0.23	I(1)	-9.50	I(0)	-53.05	I(0)	0.15	I(0)*
GE_I	-2.28	I(1)	-4.68	I(0)	0.15	I(1)	-17.79	I(0)	-21.29	I(0)	0.11	I(0)
EX	-1.04	I(1)	-0.93	I(1)	0.92	I(1)	-8.21	I(0)	-8.16	I(0)	0.24	I(0)
IN	-1.04	I(1)	-0.26	I(1)	0.70	I(1)	-4.62	I(0)	-4.76	I(0)	0.23	I(0)
OP	-1.60	I(1)	-1.50	I(1)	0.96	I(1)	-8.08	I(0)	-8.05	I(0)	0.14	I(0)

*significant at 1%, while the other results are significant at 5%

Appendix 2.D: VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	887.4653	NA	2.06E-15	-16.78981	-16.63816	-16.72836
1	999.3829	208.9129	4.85e-16*	-18.23586*	-17.17428*	-17.80569*
2	1032.469	57.97864*	5.16E-16	-18.18035	-16.20884	-17.38146
3	1060.304	45.59705	6.13E-16	-18.02484	-15.14339	-16.85722

CHAPTER 3

3 TRADE AND FISCAL BALANCES IN AN OIL-BASED ECONOMY – THE OMANI EXPERIENCE

3.1 Introduction

Oil price fluctuations have an impact on both fiscal balance and external balance in oil-exporting countries such as Oman. Thus, oil prices are an important determinant of current account balance and fiscal policy in these countries. An increase in oil price has an impact on fiscal revenue and expenditure. Higher exports revenue from oil increases the government's ability to spend, leading to expansionary fiscal policy (Akanbi, 2015). Oil-exporting countries tend to be less diversified and heavily dependent on oil revenue, steering to a strong linkage between the public saving and the current account balance (Arezki & Hasanov, 2013). Thus, the degree of economic diversification determines the relationship between the oil price and the current account, which determines the economy's ability to absorb oil price shocks. But most of the developing commodity exporters have low trade diversification, and the current account balance is strongly linked to oil price changes (Gnimassoun et al., 2017).

Assessing the relationship between the current account and fiscal policy provides a good guide for policymakers to achieve macroeconomic stability (Akanbi, 2015). For developing oil exporters such as Oman, changes in oil prices have been the main driver of both fiscal and current account balances over the years (CBO, 2019). This imposes fiscal challenges and uncertainty for oil-exporting countries since oil is an exhaustible resource, with fluctuating prices that are sensitive to the international market (Le & Chang, 2013).

The nexus between the fiscal deficit and the current account deficit gained particular attention in the United States (US) in the 1980s during the Reagan Administration, which accumulated government budget deficit led to the current account deficit, commonly known as 'Twin Deficits Hypothesis (TDH)' (Enders & Lee, 1990).

We argue that TDH may not be applicable to countries such as Oman. The reason being, Oman follows a pegged exchange rate regime, where the Omani rial is pegged to the US dollar since 1973 (CBO, 2018a), while no restrictions are imposed on foreign capital flow movements (Al-Faris, 2002). The focus of monetary policy tends towards maintaining the exchange rate stability, which is deemed necessary by the Central Bank of Oman to promote sustainable growth and to achieve price and financial stability in an open economy environment. Compared to that, the traditional theoretical relationship between fiscal deficit and current account deficit may be more applicable for economies with flexible exchange rate, where the interest rate and exchange rate are managed by the central banks. The TDH theory is more relevant to countries where fiscal revenue relies more on tax contribution. For Oman, the contribution of taxes to the total government revenue was 12.25%, 10.38%, and 9.18% in 2016, 2017, and 2018, respectively, and taxes contributed to the non-oil government revenue segment by 38.52%, 38.31%, and 42.2% of the same three years respectively (NCSI, 2019).

Following the drop in oil prices between 2014 and 2016, the current account balance in oil-exporting countries in the Middle East and North Africa shifted from 8.80% of surplus to GDP to 3.60% of deficit to GDP (IMF, 2017). Following the recovery of oil price in 2018, the current account balance shifted back to a surplus of 8.00% of GDP. Though the position remains weak in countries like Oman, Yemen, Bahrain, and Algeria (IMF, 2018).

This study aims to fill the gap in the literature related to the relationship and causality effect between the fiscal balance (FB) and the trade balance (TB) in oil-exporting countries and to contribute with empirical work to the political discussion about the relation between the fiscal deficit and current account deficit. We test the TDH for the Omani economy in the short run and the long run, using the structural vector autoregressive (SVAR) model, and the structural vector error correction (SVECM) model respectively for the period 1989Q4 to 2017Q4. We use trade balance, fiscal balance, and oil prices to assess the short-run relationship while using oil prices, exports, imports, government expenditure, and government revenue to assess the long-run relationship. Compared to other studies on oil-dependent economies, this study includes the oil price in the short and long-run analyses.

In the short run, results show that oil price has an impact on both FB and TB for the Omani economy, and the direction of causality runs from TB to FB which is opposite to the TDH. TB and FB respond positively to oil price shock while they respond negatively to oil price volatility shock.

By dividing the study period into three sub-periods: the first period which includes Kuwait invasion, the second period includes Kuwait invasion, and Asian Financial Crisis (AFC), last period includes Kuwait invasion, AFC, and Global Financial Crisis (GFC). The results are consistent across the three sub-periods where the responses of TB to a positive oil price shock is higher compared to FB responses. TB responds positively to the FB shock only in the first sub-period and responds negatively in the two later sub-periods. Compared to that, FB responds positively to TB shocks in all three sub-periods. This outcome is not surprising, as Oman’s trade balance is dominated by oil export, an exogenous variable in the domestic economy, being influenced by global oil prices and global trends. The first sub-period includes high oil prices driven by a precautionary oil demand shock associated with the Kuwait invasion; in contrast, the latter sub-periods include low realized oil prices driven by low global demand.

In the long-run analysis, there are two cointegration relationships identified between the oil price, government revenue, government expenditure, exports, and imports. The cointegration vectors are normalised on government expenditure for the first equation and on imports in the second equation. The results show oil price shocks have a statistically significant positive impact on government revenue, exports, and imports which is consistent with the positive short-run responses of FB and TB. In contrast, the response of government expenditure to oil price shocks is statistically insignificant. Government expenditure, however, responds statistically significant to government revenue shock but not vice versa. On the trade side, imports respond to the exports shock but not vice versa, implying there is a unidirectional impact from government revenue and exports toward government expenditure and imports respectively.

The remaining of the study is structured as follows: Section 3.2 discusses in more detail the twin deficit and oil price, while section 3.3 gives an overview of the Omani economy. Section 3.4 examines the short-run relationship while section 3.5 illustrates the long-run relationship and section 3.6 concludes.

3.2 Fiscal deficit, current account deficit, and oil price

In this section, we present the four streams of twin deficit arguments in the literature. Then, we discuss the literature on the impact of oil price on fiscal deficit and current account deficit.

3.2.1 Four streams of twin deficit arguments

The relationship and causality direction between the government budget deficit and current account deficit is a debated topic. There are four streams of literature that explain the nexus between the government budget deficit and the current account deficit. The first stream is the TDH based on the Keynesian macroeconomic model which argues that there is a unidirectional relationship from government budget deficit to current account deficit (Abell, 1990; Akbostanci & Tunç, 2001; Algieri, 2013). The transmission mechanism between the two variables can be explained by the Keynesian absorption theory and the Mundell-Fleming framework. According to the Keynesian absorption theory, a rise in the budget deficit through tax cuts or government expenditure increases, raises the domestic absorption through imports expansion caused by the income increase, leading to current account deficit (Feldstein, 1991; Elhendawy, 2014). Compared to that, the Mundell-Fleming framework assumes that under the flexible exchange rate regime, an increase in the government budget deficit raises the domestic interest rate which attracts the foreign capital inflows and consequently appreciates the domestic currency. The domestic currency appreciation increases imports spending and decreases exports competitiveness, leading to a current account deficit. Even under the fixed exchange rate regime, the rise in domestic prices due to expansionary fiscal measures can deteriorate the current account balance (Fleming, 1962; Mundell, 1963; Anoruo & Ramchander, 1998; Salvatore, 2006).

The second stream is associated with the Ricardian Equivalence Theorem, which assumes no systematic relationship between the budget deficit and the current account deficit. According to this theory, an increase in government deficit financed through bonds will not lead to an increase in income or interest rate. The households are assumed to save the revenue they gained from the expansion, expecting the government will increase the taxes in the future to finance the debt. Therefore, lower public saving is covered by an equal increase in private savings, avoiding any need to borrow from abroad. As a result, the current account does not respond to the changes in the government fiscal balance or government spending (Barro, 1974, 1989).

The third stream is the Current Account Targeting Hypothesis, which assume unidirectional causality in the opposite direction to the Keynesian absorption theory and Mundell-Fleming framework. According to this hypothesis, the nation attempts to maintain external balance, as any deterioration in the current account leads to a slower pace of economic growth and increases the fiscal deficit. This appears to be true, especially for small open economies with high debt, and the debt services will be inflated and worsen the external balance (Summers, 1988). This assumption is a phenomenon in small open economies that depend on foreign loans to finance investment and economic development. The accumulation of loans will inflate debt service payments in the current account, leading to current account deficit and ultimately to budget deficit to finance it (Helmy, 2018). Finally, some authors assume bidirectional causality between the government budget deficit and the current account deficit. Taken together, there is no agreement if the budget deficit causes the current account deficit or vice versa (Kouassi et al., 2004).

From the above discussions, we can divide the causality between the fiscal deficit and the current account deficit into the intertemporal transmission and the intertemporal response mechanisms. According to the intertemporal transmission mechanism, a change in government fiscal measure will influence the domestic aggregate demand, which will affect the interest rate, therefore, leads to capital inflow/ outflow and exchange rate appreciation/ depreciation as in Keynesian and Mundell-Fleming modelling framework. Through this transmission mechanism between fiscal policy and the current account balance indicates that any improvement in one variable is expected to be translated into an improvement in the second variable and vice versa. The intertemporal response mechanism, on the other hand looks at the responses of private agents to government fiscal policy actions, assuming the change in the government saving is offset by private saving leading toward Ricardian outcome (Akanbi, 2015). The causation between the fiscal deficit and the current account deficit also depends on a number of factors such as exchange rate regimes, degree of economic openness to the global system, changes in output gaps, and the initial level of debt in economies under consideration (Abbas et al., 2011; Akanbi & Sbia, 2017).

3.2.2 A review of the empirical literature on the twin deficit hypothesis

As the theoretical explanations for the relationship between government fiscal deficit and current account deficit are debated; the empirical studies also come with mixed results with no clear consensus (Kouassi et al., 2004; Xie & Chen, 2014). Traditionally there are two ways to test the relationship between the government budget deficit and the current account deficit. The first is to test the direct relationship between the two variables and the second approach is to test the indirect relationship through the intermediate links such as interest rate and exchange rate channels (Salvatore, 2006). The results of testing the relationship between the nexus have produced different outcomes for different countries, and the findings even differ for the same country when using different econometric techniques, sample periods, and model specifications (Algieri, 2013; Xie & Chen, 2014).

Abell (1990) supported empirically the Keynesian absorption theory and Mundell-Fleming theory for the US economy, that the relationship runs from the fiscal deficit to the current account deficit. He demonstrated the link between the two deficit is indirect, and the causality runs from government budget deficit to higher interest rate, to foreign capital inflow which causes an appreciation of exchange rate and finally leads to the trade deficit. Likewise, Ahmad et al. (2015) found that six out of nine African countries under the examination support the convergence hypothesis for twin deficit and current account deficit. Akbostanci and Tunç (2001) support the twin deficit hypothesis for Turkey, while the Ricardian equivalence hypothesis is not valid. Some empirical results supported the bi-directional causality relationship (Xie & Chen, 2014). On the contrary, Corsetti and Müller (2006), Müller (2008), and Kim and Roubini (2008), found that the budget deficit caused by tax cuts and fiscal expansion improve the current account position which some labelled it as ‘twin divergence’. Studies such as Bouakez et al. (2014) and Kumhof and Laxton (2013), Bartolini and Lahiri (2006), and Enders and Lee (1990) conclude that there is a weak or no link between the fiscal deficit and current account deficit with some support for the Ricardian Equivalence Hypothesis.

The reverse causality running from the current account to budget deficit is consistent with the empirical studies by Helmy (2018), Kalou and Paleologou (2012), Marinheiro (2008), Kim and Kim (2006), and Anoruo and Ramchander (1998). Badinger et al. (2017) included fiscal rules like stringent balanced budget or debt rules into the empirical investigation for the twin deficit hypothesis.

Alkswani (2000) pays special attention to the twin deficit phenomena for an oil-dependent economy, such as the Saudi Arabia economy where oil is the main source of exports and government revenue. For Saudi Arabia, the Keynesian proposition is partially valid, but the causality is reversed from a trade deficit to a budget deficit. Similarly, for Kuwait, the causality runs from the current account to fiscal stance, and the trade balance surplus leads to current account surplus. This surplus in trade and current account may cause the budget deficit as the government spending initiated and increase by trade balance surplus for the oil-based economy (Merza et al., 2012). Thus, higher exports revenue from oil price influences the government's spending towards expansionary fiscal policy (Akanbi, 2015). Amaghionyeodiwe and Akinyemi (2015) found reverse causation for Nigeria which is an African oil-based economy and concludes with a recommendation to reduce the twin deficit phenomenon by diversifying the exports base and promoting non-oil exports. Akanbi (2015) also investigates the link between fiscal policy and current account for Nigeria, by taking into consideration the role of oil price which is the main driver for fiscal balance and current account balance, and the finding confirms the existence of twin deficit. Though Akanbi (2015) found a positive relationship between government budget and current account balance, when he just focused on the non-oil part of the economy, he found the relationship to be negative.

3.2.3 Role of the oil price shock and fiscal balance

For oil exporters, particularly Middle Eastern countries, oil is the main source of exports and government revenue. For oil-exporting countries, fiscal policies are the propagation channel for oil price volatility to the economy (Alley, 2016). For these countries, oil contributes a high percentage to government revenue, and the oil revenue is mainly managed by the governments. In addition, government expenditure has a dominant role in the market (Al-Faris, 2002; Tazhibayeva et al., 2008; Arezki & Ismail, 2013; Alley, 2016). Therefore, oil price movements affect these economies through their fiscal policy measures (Alley, 2016). For instance, in the Gulf Cooperation Countries (GCCs), the fiscal policy tends to be procyclical with international oil prices (Al-Faris, 2002; Fasano & Wang, 2002). Moreover, even an improvement in the fiscal balance due to oil price increase can be wiped-off by the underperforming non-oil sector (Akanbi, 2015).

For oil exporters in the Middle East and North Africa, the fiscal breakeven oil price, the price at which the fiscal balance is zero remain significantly above the oil prices trajectory, and the fiscal consolidation is slow. In 2014 the oil price was 103.20 US$/BBL and the breakeven price for Kuwait, Oman and Libya was 54.30, 94.81, and 206.03 US$/BBL, respectively. In 2016 the oil price dropped to 40.10 US$/BBL and the fiscal breakeven price dropped only to 43.42 US$/BBL for Kuwait but increased to 101.68 US$/BBL for Oman and 244.47 US$/BBL for Libya.

Currently, the limited fiscal space coupled with elevated public debt requires swift and substantial economic policy actions to rebuild fiscal space and to insulate the economies from oil price swings (IMF, 2019). In this regard, effective independent fiscal policy actions are essential for oil exporters to deal with oil price fluctuations, for instance, the oil-exporting governments can use non-oil primary balance as guidance for policymaking (IMF, 2018).

Despite a variety of uncertainties in both the global economy and oil markets, the oil demand is predicted to reach 104.80 mb/d by 2040 compared to 98.70 mb/d in 2018, due to expected growth in the petrochemical sector, road transportation, and aviation. Although some countries, mainly developed nations tend to reduce oil demand for environmental, energy dependence, and other concerns (OPEC, 2019), the demand for oil by developing nations is expected to grow due to population growth and economic expansions.

3.2.4 Role of the oil price shock and current account balance

The external adjustment for the economy can be achieved through the trade channel and financial channel; the former is through the changes in the quantity and prices of goods and services while the latter is through the changes in asset prices and returns (Ghironi et al., 2015). There are many studies such as Gnimassoun et al. (2017), Allegret et al. (2014), Le and Chang (2013), and Kilian et al. (2009) that examined the relationship between oil price shocks and the external account for oil-exporting and importing countries.

In the oil market, there are three different causes for oil price shocks as defined by Kilian (2009), (i) oil supply shock, (ii) aggregate demand shock caused by the global business cycle, and (iii) oil-specific demand shock, which represents the precautionary demand for oil stocks. These oil price shocks influence countries' external balance through the trade channel or financial channel (Kilian et al., 2009; Gnimassoun et al., 2017). The adjustment of quantities and prices of goods exported and imported reflects the response of the trade account to these shocks. The change in the external portfolio is the financial channel, which works through the adjustment of income flow and the foreign liability position that reflects the international portfolio structure of oil-exporting and importing economies. Therefore, the adjustments to the external shocks depend on the countries' initial gross financial asset and foreign liabilities (Kilian et al., 2009).

The dynamics of international oil prices determine the amount of exports revenue for developing oil-exporting economies. In these countries, oil revenue is the main source of income and foreign exchange (Allegret et al., 2014). Moreover, most of the oil and gas exporters invest their money in rich developed economies, and any changes in the oil windfall in these countries may lead to global imbalance. Generally, oil-exporting countries use the oil money in two ways, i.e. spend them or accumulate them as a foreign asset, and this decision has an impact on the global imbalance (Arezki & Hasanov, 2013). Another factor is the degree of financial development in oil-exporting countries, which has an impact on how oil revenue is allocated.

There is a growing concern about the spill over of crises between economies through the global current account imbalances due to macroeconomic interdependence among countries (Kumhof & Laxton, 2013). This imbalance is caused by financial integration among heterogeneous financial markets across countries (Mendoza et al., 2009). Thus, the inefficient financial markets in oil-exporting countries contribute to the ‘saving glut’ as they send their excess capital from oil revenue to the developed financial markets (Bernanke, 2005) cited by (Allegret et al., 2014).

Some studies assume the possible drivers for the time-varying nature of the relationship between oil price and current account are: energy market regulation, oil intensity of economic activity, the capacity utilization rate in crude oil production, the degree of oil market finalization (Baumeister & Peersman, 2013). Based on the previous studies, the effect of oil price on the current account depends on the characteristic of each economy, i.e. whether they are oil importers/ exporters, the level of domestic financial markets development, the level of integration with the international financial market, and the ability to manage the foreign exchange rate reserves. Therefore, no clear cut conclusion about the impact can be made (Buetzer et al., 2012) cited (Gnimassoun et al., 2017).

There is a possible indirect negative impact of oil price increase on oil-exporting countries, as higher oil prices may increase the imports costs or with less extend decrease their exports of oil to importing countries. But the net impact on the trade balance depends on how much the increase in the oil exports revenue compared to the increase in imports cost (Le & Chang, 2013). There is a positive relationship between oil price and current account in the oil-exporting countries, as the oil price increase causes a surplus in the current account. Some studies assume the oil demand shock has a positive and significant impact on the current account, compared to unanticipated oil price increase caused by production shortfall (Kilian et al., 2009; Gnimassoun et al., 2017). In terms of the impact of the exchange rate, there is a small economic impact of the real exchange rate on the current account in oil-exporting countries as most exports are in US dollars and the imports are driven by government investment strategy (Arezki & Hasanov, 2013).

3.3 An overview of the Omani economy

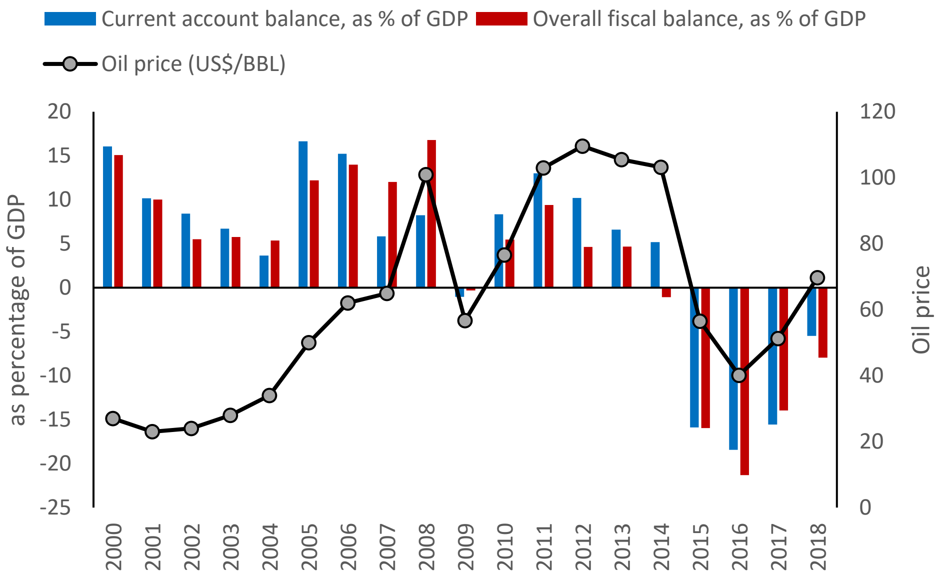
This section gives an overview of the Omani economy in two sub-sections; the first sub-section discusses the government budget and current account, and the second sub-section presents the external balance.

3.3.1 The government budget and current account

In the modern Omani economy petroleum is a vital economic sector that contributed 41.80%, 40.40%, and 40.80% to Omani GDP in 2016, 2017, and 2018, respectively. Petroleum is also the main exported commodity and its contribution to Omani exports value was 57.93%, 58.22%, and 65.31% in 2016, 2017, and 2018, respectively. Oil is also the major source of government income and contributes by 68.19% 72.89% and 78.24% to government revenue in 2016, 2017, and 2018, respectively (NCSI, 2019).

As discussed in Chapter 2 and like other oil exporters, it is well established that the fall in oil price negatively impacts the Omani economy through the fiscal and macroeconomic variables (see for example Esfahani et al., 2013; Hamdi & Sbia, 2013; Alley, 2016). In terms of the relationship between fiscal and current accounts, some studies such as Al-Fazari (2006) and Hashemzadeh and Wilson (2006) argue that the Keynesian model explains the nexus of fiscal deficit and current account deficit in Oman. According to these studies, there is unidirectional causality from budget deficit to current account and trade deficit, hence a better management of fiscal deficit will help in the external balance. The Central Bank of Oman's annual report stated that 'Oman is experiencing twin deficits problem with both fiscal balance and current account balance turning into deficits, and the former is driving the latter' (CBO, 2017). A quick glance at Figure 3.1 below shows the current account balance and fiscal balance have a common trend, and both follow the oil price trend. In 2009 oil prices have a clear downside associated with GFC and another fall in oil price was observed between 2014 and 2018. Figure 3.1 clearly demonstrates a surge in fiscal and current account deficit since 2014.

Figure 3.1. Current account balance, overall fiscal balance and oil price (2000-2018)



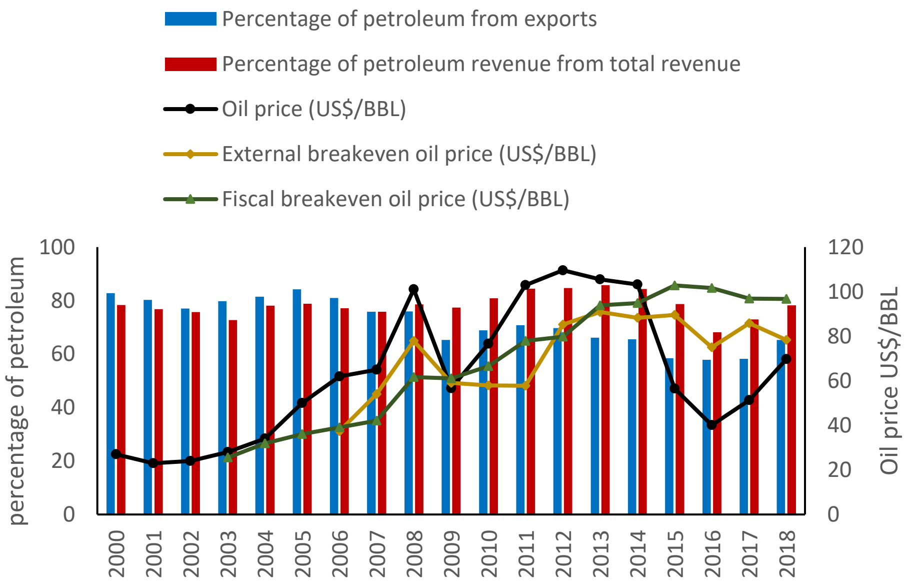
Source: Different issues of the statistical yearbook, NCSI, and IMF.

Figure 3.2 illustrates the high contribution of petroleum to exports and government revenue between 2000 and 2018. The figure shows three different oil prices: - market oil price, external breakeven oil price, and fiscal breakeven oil price. External breakeven oil price is the price at which the current account balance is zero, while the fiscal breakeven oil price is the price at which the fiscal balance is zero.

While the realized oil price is fluctuating, the fiscal breakeven oil price increasing steadily over time. The external breakeven oil price is also increasing but is much flatter, while since 2014 the realized oil price is below these prices, which results in the trade deficit and fiscal deficit.

Two-thirds of the government expenditure in Oman is classified as current expenditure. For example in 2016, 72.8% of the expenditure goes towards salaries while only a third of the expenditure goes towards capital expenditure (NCSI, 2017). Between 2015 and 2016 the oil price dropped by 29.03%, and the fiscal balance deficit as a percentage of GDP increased from 17.20% in 2015 to 20.80% in 2016. This deficit was 73.00% funded through an external loan, 17.00% from the reserve fund and the remaining 10.00% by issuing domestic bonds (CBO, 2017). External loans are an important issue to consider as both debt and debt services are raising, but this is beyond the scope of this study.

Figure 3.2. Contribution of petroleum in exports and total government revenue, external breakeven oil price, fiscal breakeven oil price and oil price (2000-2018)



Source: Different issues of the statistical yearbook, NCSI, and IMF.

3.3.2 The external balance

For more than five decades, oil and gas have been the main exported commodity for Oman. The contribution of petroleum to the export were 78.52%, 67.37%, 80.2%, and 81.19% in 1995, 1998, 2001, and 2004, respectively (NCSI, 2009). It was 76.01%, 70.84%, 65.45% and 58.22% in 2008, 2011, 2014 and 2017, respectively (NCSI, 2018). Asia is one of the most dynamic regions in global trade and a major driver of global economic growth (Dungey et al., 2018). Asia is the main destination for the Omani oil, around 83.10% exported to China, followed by India at 7.60% and Japan at 5.80% in 2018 (NCSI, 2019).

The sum of exports and imports as a percentage of GDP is an indicator of the economy's openness (Huntington, 2015). As reported in Table 3.1, exports and imports as a percentage of GDP in Oman is generally more than 90%, implying a high level of trade openness. The level of trade openness tends to be sensitive to oil price movements. For example, when the oil price plunged in 2016, the level of trade openness dropped to 77.80% and subsequently increased to 84.50% and 85.80% in 2017 and 2018, respectively with oil price recovery from 51.30 US$/BBL in 2017 to 69.70 US$/BBL in 2018.

The trade balance reports the difference between merchandise exports and imports. Some studies assume in economies with high total trade as a share of GDP, the impact of the fiscal shock on the current account will be higher and more persistent (Corsetti & Müller, 2006). As Table 3.1 shows the trade balance as a percentage of GDP declined by 68.82% between 2014-2015 and by 35.63% between 2015-2016, reach to 5.60% in 2016 compared to 27.90% in 2014. The trade balance recovered and bounced back by 50.00% between 2016-2017 to 8.40% of the GDP in 2017. Compared to a 50% improvement between 2016 and 2017, the trade balance shows a big jump in 2018 by 132.14% compared to 2017. It is apparent from the table that the non-oil exports have an increasing trend between 2010 and 2013, then gradually decreases, which may indicate an indirect relationship between oil and non-oil exports.

Oil price shocks may lead to reserve depletion and borrowing from abroad to offset the adverse terms of trade shocks for both oil exporters and oil importers (Chuku et al., 2011). Since oil contributes the biggest proportion to merchandise trade of the Omani's exports, the current account balance worsens when oil prices decline (CBO, 2017).

Table 3.1. Exports and imports, trade balance and non-oil exports (2010-2018)

Trade balance	2010	2011	2012	2013	2014	2015	2016	2017	2018
Export and import as % of GDP	96.50	104.70	105.80	116.80	104.20	94.90	77.80	84.50	85.80
Trade balance as % of GDP	28.40	34.00	30.80	26.50	27.90	8.70	5.60	8.40	19.50
Non-oil export as % of GDP	19.40	20.20	20.70	24.30	22.70	21.00	17.60	19.40	18.20

Source: CBO annual report issues: 2015-2019.

In 2018, the Omani merchandise exports included crude oil for 48.00%, refined oil for 7.00%, liquefied natural gas (LNG) for 11.00%, non-oil exports for 23.00%, and re-exports for 11.00%. About 22.40% of the value of non-oil exports and re-exports are mineral fuels, lubricants, and similar materials, followed by chemicals and their products for 20.60% and machinery and transportation equipment for 19.60%. In contrast, machinery and transport equipment accounted for about 33.30% of the total value of the imports and manufactured goods by 22.70% (NCSI, 2019).

Table 3.2 shows that between 2010 and 2011, the oil price increased by 34.33%, raising both exports and imports by 28.66% and 20.26% respectively. In comparison, between 2012 and 2013, the oil price fell by 3.74%, exports and imports increased by only 8.23% and 24.24%. Between 2014 and

2015 the oil price shows the highest fall in recent years by 45.25%. This led to exports and imports declining by 33.38% and 4.08%, respectively. In contrast, between 2016 and 2017 the oil price recovered by 27.93% ,which drives the exports to increase by 19.39% and imports by 13.32%.

Table 3.2. Change in oil price, imports and exports and its components (2010-2018)

% of change	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
oil price	34.33	6.51	-3.74	-2.18	-45.25	-29.03	27.93	35.87
imports	20.26	19.22	24.24	-13.02	-4.08	-19.87	13.32	-2.46
exports	28.66	10.72	8.23	-5.07	-33.38	-22.81	19.39	26.89
crude oil	33.12	10.65	4.60	-6.05	-42.35	-26.12	17.39	33.35
refined oil	34.21	-20.08	-38.81	-9.21	-40.65	1.63	116.76	157.45
LNG	24.92	9.90	3.44	-2.67	-21.28	-20.85	15.13	47.20
non-oil	23.90	18.49	5.92	8.37	-27.19	-20.15	32.42	17.33
re-export	16.96	10.62	42.44	-16.87	-12.65	-20.04	2.23	-12.87

Source: CBO annual report issues: 2015-2019 and NCSI statistical yearly book 2019.

Moving to the current account, both goods and current transfers are the highest components compared to services and income as shown in Appendix 3.A. Between 2010 and 2014, the current account was positive. Between 2013 and 2014, oil prices fell by 2.18% thus the current account surplus decreased from 6.70% of GDP in 2013 to 5.10% of GDP in 2014. Indeed, the Central Bank of Oman expected that low oil prices would affect the country’s external balance in 2015 and that the current account at least will be flat or in deficit (CBO, 2015). As predicted, in 2015 the current account recorded a deficit of 15.70% of GDP due to a sharp decline in Oman crude oil price by 45.25% from 103.20 US$/BBL in 2014 to 56.50 US$/BBL in 2015, although the quantity of oil exported increased by 5.40% (CBO, 2016a).

Between 2015 and 2016 the oil price plunged by 29.03%, recording 40.10 US$/BBL in 2016. Driven by low oil prices, the current account deficit increased to 18.6 % of GDP in 2016 from 15.7% of GDP in 2015. The current account deficit in 2016 was largely attributed to a substantial decline in merchandise trade reflecting low crude oil prices. In that year the value of all export categories also declined as Table 3.2 shows, except the refinery oil which increased slightly by 1.6%; the crude oil exports contracted by 26.1%, the natural gas declined by 20.9%, the re-export and non-oil export declined by 20.0% and 20.1%, respectively, caused by subdued in economic growth in the importing countries. Due to low oil prices, the value of crude oil exports declined during the year, even though the quantity increased by 5.40%. The Central Bank of Oman predicted a continued fall in oil prices would cause more adverse impacts on the trade balance and current account balance (CBO, 2017). Between 2017 and 2018 oil price improved by 35.87% to 69.70 US$/BBL but was still under the external breakeven price which was 84.15 US$/BBL. Therefore, the current account deficit declined to 5.5% of GDP from 15.5% in 2017 (CBO, 2019).

The gross national saving includes the gross domestic saving, net primary income from abroad, and net current transfers from abroad. Overall, the latter two are negative for the Omani economy. Higher growth in national savings compared to domestic saving means a higher share of saving available for the domestic investment and indicates a smaller amount of leakages from the domestic economy.

The leakage from gross domestic saving is mainly in the form of remittance of expatriate workers and investment income like net interest and dividends paid on external liabilities (CBO, 2017). The workers' remittance account for 78% of the saving leakage (CBO, 2019) as the GCCs use non-restriction policy on the capital movements (Al-Faris, 2002). Current transfers associated with the worker remittances increased by 13.1% in 2014 over 2013 (CBO, 2015), and increased by 6.7% in 2015 'reflecting a continued increase in expatriate employment in Oman, particularly in the private sector'(CBO, 2016a).

Despite the launch of the 'Omanisation policy',[26] which aims to reduce the high percentage of expatriates mainly in the private sector to mitigate the impact of remittances on the current account (Al-Fazari, 2006). About 86.29% of the workforce in the private sector and 100% of the family (domestic chore) workers are still foreigners (NCSI, 2018). Thus, such leakages through remittances and imports could weaken significantly the fiscal multipliers (Espinoza & Senhadji, 2011).

As the oil price dropped, the percentage of leakage escalated from 15.90% in 2013 to 19.30% and 18.60% in 2015 and 2016, respectively, as Table 3.3 shows. In addition to that, the elevation of external debt due to the growing fiscal deficit (CBO, 2019) has led to higher debt cost and higher debt service which will have a numerous influence on the current account balance in the future.

From Table 3.3, it worth noting that the ratio of the net foreign asset (NFA) of the central bank and ratio of the net foreign asset of the banking system to M2 also decreased between 2014 and 2016. When the oil price dropped by 29.03% between 2015 and 2016, the current account deficit increased from 15.70% of GDP to 18.60%, the deficit bridged by drowning down the foreign exchange reserve, thus declining the net foreign asset of the central bank (CBO, 2017).

[26] Omanisation was one of the main objectives of Oman Vision 2020 that was prepared in 1995, https://journals.lib.unb.ca/index.php/jcim/article/view/462/771.

Table 3.3. Gross domestic saving, gross national saving, and the ratios of net foreign asset (2010-2017)

	2010	2011	2012	2013	2014	2015	2016	2017
Gross domestic saving as % of GDP	49.90	53.70	54.40	48.90	44.40	33.50	29.10	34.10
Gross national saving as % of GDP	33.70	36.70	37.80	33.00	25.60	14.30	9.50	15.90
Leakage	16.20	17.00	16.60	15.90	18.30	19.30	18.60	18.20
Ratio of NFA of CBO to reserve money	2.20	3.00	2.20	2.30	1.90	1.30	1.70	1.60
Ratio of NFA of banking system to M2	0.60	0.60	0.50	0.60	0.50	0.30	0.30	0.30

Source: CBO annual report issues: 2015-2019.

3.4 Twin deficit in the short run

This section examines the twin deficits in the short run using a structural vector autoregression (SVAR) model. From the literature review as reported in Appendix 3.B, SVAR is widely used to test the twin deficits hypothesis empirically, and the common variables used are trade balance, budget balance, current account balance, public debt, imports, exports, exchange rate, and interest rate.

3.4.1 Data and methodology

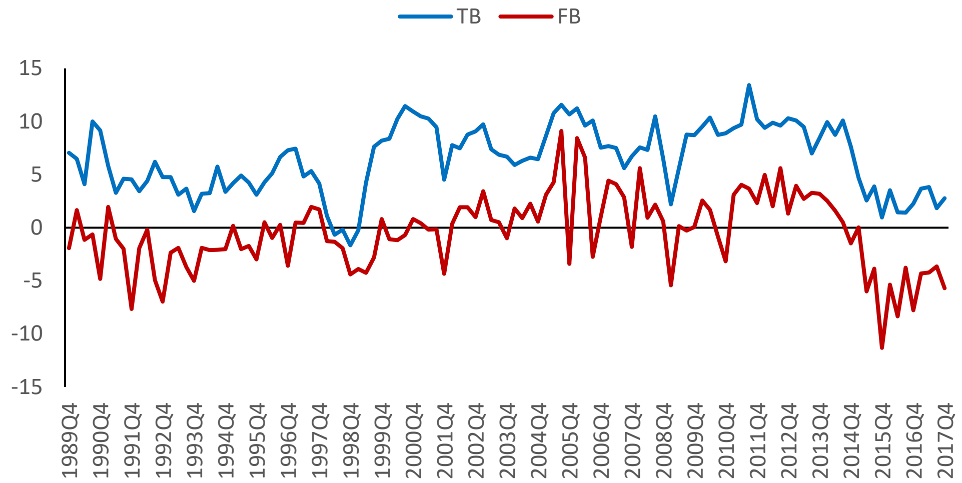
In this section, we will investigate the short run relationship between the fiscal balance (FB) and the trade balance (TB) of Oman. Consistent with the literature, both variables are measured as a percentage of real GDP, with a quarterly frequency between 1989Q4 and 2017Q4. The source of data is the statistical bulletin published by the National Centre of Statistics and Information (NCSI), refer to Appendix 3.C for more details on data description.[27] Figure 3.3 shows there is a unison co-movement between FB and TB which can deem as an indicator of twin deficit phenomena. We use TB instead of the current account balance since oil contributes highly to both trade and government revenue for the Oman economy. Thus, the oil price is included in our second model specification to assess the role of oil in linking the trade balance and fiscal balance.

The major falls in oil prices are observed in the early and mid-1980s, in 1991, after the AFC, and in late 2008. The oil price (in log) movements in Figure 3.4 show that oil price increases in 1990/91 following the invasion of Kuwait (Kilian, 2010). This reflects speculative demand shocks due to forward-looking behaviour in response to supply disturbances. Figure 3.4 also highlights three demand-driven oil shocks: (i) between 1997 to 1999, the decrease in demand for crude oil caused by AFC followed by an economic crisis in Russia, Brazil, and Argentina. (ii) Between 2008 to 2009, the decline in demand for industrial commodities including crude oil due to the global recession and the GFC. And (iii) between 2014 to 2016 oil price fall caused by sluggish global economic activity, increases in US shale oil production, increases in oil production from Canada and Russia and less impact from geopolitical conflict on the supply of oil in the Middle East (Baumeister & Kilian, 2016; Koh, 2016).

[27] https://www.ncsi.gov.om/Elibrary/Pages/LibraryContentView.aspx

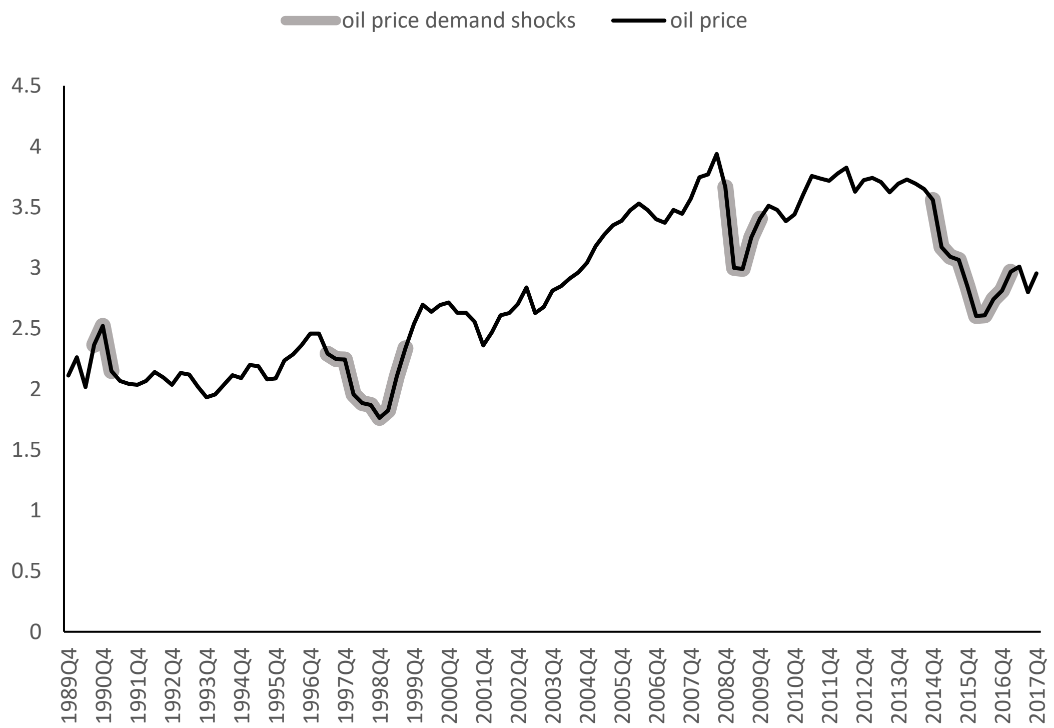
The period under consideration also includes the tranquil period till 2007 and the post-GFC period (Raghavan, 2020).

Figure 3.3. Trade balance and fiscal balance as a percentage of the GDP



Source: Different issues of the monthly statistical bulletin, NCSI.

Figure 3.4. Oil price with one positive demand shock and three negative demand shocks from AFC, GFC, and oil price drop between 2014 and 2017



Between the supply and demand-driven oil shocks, the demand-driven oil shocks caused by an increase in the precautionary demand for oil or an increase in aggregate demand for all industrial commodities including oil, have more impact on oil price compared to supply-driven shocks (Kilian, 2009). It is important for policymakers, financial analysts, and economists to understand the different dynamics of the effects of supply and demand related shocks and the changing nature of the shock transmissions in the global oil market (Raghavan, 2020).

The investigation of twin deficit phenomena started with the use of a simple single equation models, then expanded to include the vector autoregressive model to assess the short term relationship and the vector error correction models to assess the long term relationship (Corsetti & Müller, 2006; Müller, 2008; Abbas et al., 2011; Ahmad et al., 2015).

3.4.2 The SVAR model

To study the relationship between TB and FB, and the impact of oil price (OP), we include the three variables in the VAR framework:

$$y_t = [OP, TB, FB]'$$

The macroeconomic relationship among these variables is modelled using a structural vector autoregression (SVAR) model,

$$\mathbf{B}_0 y_t = \mathbf{B}_i y_{t-1} + \cdots + \mathbf{B}_\mathrm{p} y_{t-p} + \varepsilon_t \qquad (3.1)$$

Where y_t is $(N \times 1)$ vector of the endogenous variables at time t. The dimension of $\mathbf{B}_0$ is a $(N \times N)$ matrix that illustrates the contemporaneous relationship between the variables. The $\mathbf{B}_i$ where $i = 1, \ldots, p,$ show how each variable is affected by its own lag as well as by lags of the other variables and ε_t is a $(N \times 1)$ vector of structural disturbances mutually uncorrelated with white noise properties. In this research, three lags are used based on lag order selection criteria results reported in Appendix 3.D.

Since ε_t and $\mathbf{B}_0, \ldots, \mathbf{B}_p$ cannot be estimated in equation (3.1), we estimate through the reduced form of VAR model which can be expressed as,

$$y_t = \mathbf{A}_1 y_{t-1} + \cdots + \mathbf{A}_p y_{t-p} + \mathrm{e_t} \qquad (3.2)$$

Here we have $\mathbf{A}_i = \mathbf{B}_0^{-1}\mathbf{B}_i$, $\mathbf{A}_p = \mathbf{B}_0^{-1}\mathbf{B}_p$ and $\mathbf{e_t} = \mathbf{B}_0^{-1}\varepsilon_t$

This matrix allows us to express the typically mutually correlated reduced form innovation (e_t) as weighted averages of the mutually uncorrelated structural innovations (ε_t) and the elements of B_0^{-1} serving as the weights.

We can express the reduced form equation (3.2) in terms of the lag operator:

$$y_t - \sum_{i=1}^{p} \mathbf{A}_i y_{t-i} = e_t$$

$$(I - \mathbf{A}_1 L - \mathbf{A}_2 L^2 - \cdots - \mathbf{A}_p L^P) y_t = e_t$$

$$\mathbf{A}(L) y_t = e_t \qquad (3.3)$$

So, $L^P y_t = y_{t-P}$ defines the lag operator and $\mathbf{A}(L) = I_N - \mathbf{A}_1 L - \cdots - \mathbf{A}_p L^p$ (3.4)

and the inverse of (3.4) gives the vector moving average to identify the dynamic properties of the VAR

$$y_t = \mathbf{A}(L)^{-1} e_t = \mathbf{\Theta}(L) e_t = \mathbf{\Theta}(L) B_0^{-1} \varepsilon_t \qquad (3.5)$$

Where $\mathbf{\Theta}(\mathrm{L}) = \mathbf{\Theta}_0 + \mathbf{\Theta}_1 L + \cdots + \mathbf{\Theta}_q L^q$ therefore, the impact of a shock in e_t on the dependent variables in the future $y_t, y_{t+1}, y_{t+2}, \ldots$ are respectively the $(N \times N)$ parameter matrices $\mathbf{\Theta}_0, \mathbf{\Theta}_1, \mathbf{\Theta}_2, \ldots$.

Through the moving average we can get the impulse response function (IRF) and the forecast error variance decomposition (FEVD). IRF traces the impact of an unexpected shock in current and future errors of one variable on the other variables while holding other shocks constant. The FEVD is the percentage of the variance in the error of a variable associated with a specific shock in the model and depends critically on the orthogonality of underlying shocks (Stock & Watson, 2001).

The first step is to test the data for stationarity using three different unit root tests: Augmented Dickey-Fuller (ADF), Philips –Perron (PP), and Kwiatkowski-Philips-Schmid-Shin (KPSS). This step is important to determine if the series is stationary for our short-run analysis. As reported in Appendix 3.E, OP is integrated I(1) while the TB and FB are stationary in level. Therefore, we will proceed using SVAR after taking the first difference of the oil price.

In our model, we expect OP will affect the TB and FB contemporaneously and in lag, as Table 3.4 shows, while OP is not affected by TB and FB contemporaneously nor in lag. OP is the most exogenous variable, it reflects the relationship between supply and demand in the international market. Oman is a price taker and has no impact on the international oil price. In addition, Oman is not a member of OPEC, which may assume to have some influence on the oil price. In contrast, TB and FB affect each other in the lags but only TB affects FB contemporaneously. We use Cholesky decomposition to obtain the orthogonalized residuals (Eltony & Al‑Awadi, 2001; Farzanegan & Markwardt, 2009; Berument et al., 2010; Dizaji, 2014). As stated before, petroleum has a major role in the Omani economy and contributes highly to exports and government revenue. We, therefore, anticipate that oil price movements will have a significant impact on the TB and FB of Oman. Petroleum exports revenue increases the TB and also improve the FB as it is the main source for government income. Further, the petroleum sector is managed by the government; thus we assume FB affects the TB in lags because of government expenditure contributions in the petroleum sector.

Table 3.4. The hypothesised relationship between oil price and domestic variables in lag

Dependent variable	Independent variable		
	OP	TB	FB
OP	*		
TB	*	*	*
FB	*	*	*

To identify structural shocks the model should be exactly or over-identified. $\mathbf{B}_0$ has K^2 parameters, so we need at least $\frac{K(K-1)}{2}$ restriction to impose on $\mathbf{B}_0$. Thus, the restriction on $\mathbf{B}_0$ matrix on the relationship $e_t = \mathbf{B}_0\varepsilon_t$ are summarised in (3.6), where e_t and ε_t represent the vectors of reduced and structural-form disturbances, respectively. e_{op} is oil price shock, e_{TB} is trade balance shock, and e_{FB} is fiscal balance shock.

$$\begin{bmatrix} e_{OP,t} \\ e_{TB,t} \\ e_{FB,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ \alpha_{21}^{(0)} & 1 & 0 \\ \alpha_{31}^{(0)} & \alpha_{32}^{(0)} & 1 \end{bmatrix} \times \begin{bmatrix} \varepsilon_{OP,t} \\ \varepsilon_{TB,t} \\ \varepsilon_{FB,t} \end{bmatrix} \qquad (3.6)$$

3.4.3 Granger causality test

Granger causality test is used to test whether one variable is predictable by the other. Thus, the concept of causation in the Granger causality test does not imply an actual cause-effect relationship, but it is the contribution in improving a specific variable predictability by adding lags value of another variable. Testing that inclusion of past observations (lags) of one variable will reduce the prediction error for the another, as the equations show below:

$$A = \gamma_0 + \textstyle\sum_{k=1}^{n} \alpha_k A_{t-k} + \sum_{k=1}^{n} \delta_k B_{t-k} + \mu_t \qquad (3.7)$$

$$B = \beta_0 + \sum_{k=1}^{n} \theta_k B_{t-k} + \sum_{k=1}^{n} \varphi_k A_{t-k} + v_t$$

The Granger causality test the following null and alternative hypothesis for A in equation (3.7), Thus, we stated B is Granger cause A, if we reject the null hypothesis below,

$$H_0: \delta_1 = \delta_2 = \cdots = 0$$

$$H_1: \delta_1 \neq \delta_2 \neq \cdots \neq 0$$

Taking into consideration that Granger causality requires the use of stationary variables, i.e. using variables in their first or second differences when they are I(1) or I(2) in level (Marinheiro, 2008; Algieri, 2013), as Appendix 3.E shows the variables are stationary in first difference.

3.4.4 Empirical results and discussion

This sub-section provides the empirical results of the Granger causality test, IRF, FEVD, and historical decomposition from the SVAR model.

3.4.4.1 Granger causality for trade balance and fiscal balance

The VAR Granger causality test is carried out to determine the relationship direction between the trade balance and fiscal balance. There are two ways to test fiscal balance and trade balance nexus, the first one is to test the relationship directly between the two variables, and the second one is to test the relationship indirectly through the intermediate links such as interest rate and exchange rate. In this study we add OP as an intermediate link between FB and TB for an oil-dependent economy. Therefore, first, we test the causality between TB and FB. As shown in Table 3.5, the null hypothesis that the TB does not Granger-cause FB is rejected. This outcome aligns with our expectation, as oil is a vital exports merchandise for Oman, and its exports revenue considered as the main source of government income. In contrast, the test fails to reject the null hypothesis that FB does not Granger-cause TB. This implies there is a unidirectional relationship from TB to FB. This finding is contradictory to the direction postulated in the traditional TDH. Our result is consistent with other studies on oil-dependent economies such as Alkswani (2000) for the Saudi economy, Merza et al. (2012) for Kuwait and Amaghionyeodiwe and Akinyemi (2015) for Nigeria.

Table 3.5. VAR Granger causality test (TB and FB)

Dependent variable: FB			Dependent variable: TB		
Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.
TB	19.95	0.0002	FB	1.37	0.71
All	19.95	0.0002	All	1.37	0.71

As stated before, OP has a significant role in both the trade and fiscal balance and contributes more than 70.00% of the government revenue and more than 60.00% of the exports value in 2018 (NCSI, 2019). Thus, our conjecture is that oil prices are the link between the two balances for small open oil-based economies. Table 3.6 provides the results of the Granger causality test by adding OP to the model. Both the null hypotheses that the OP does not Granger-cause TB or FB are rejected. Consistent with the above results, the null hypothesis that the TB does not Granger-cause FB is rejected, and it fails to reject the FB does not Granger cause TB. But by testing the null hypothesis for join FB and OP, we reject the null hypothesis that both variables do not Granger cause TB. The results emphasise the importance of OP in both TB and FB and confirm the one-way relationship between TB and FB for the Omani economy.

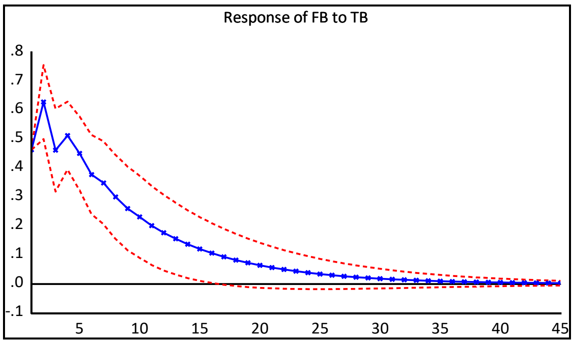
Table 3.6. VAR Granger causality test (TB, FB and oil price)

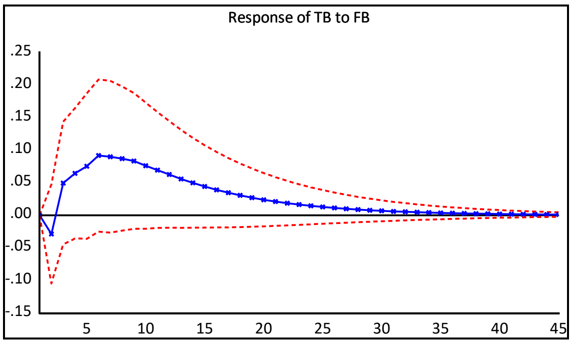
Dependent variable: FB			Dependent variable: TB		
Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.
TB	16.35	0.00	FB	2.95	0.22
OP	10.15	0.006	OP	22.05	0.00
All	23.29	0.00	All	23.91	0.00

3.4.4.2 Impulse response function

This sub-section presents the estimated IRF. The IRFs in the charts below are given with 68% confidence intervals. Figure 3.5 shows one positive standard deviation shocks and responses between the TB and the FB. One standard deviation positive shock in TB has a high and statistically significant positive impact on FB in the short term, then decreases gradually reach zero after 35 quarters. In contrast, a positive shock to FB has a negative impact on TB in the beginning, then turns to be positive after 3 quarters, the response is volatile, small, slightly significant, and has a humped shape which fades out. The outcome is consistent Merza et al. (2012) findings for Kuwait. It also aligns with Summers (1988) for the Current Account Targeting Hypothesis which assumes spill over effect runs from TB to FB, than to the Keynesian absorption theory and Mundell-Fleming framework. Though we assume the channel is different in oil-dependent economies stressing the crucial role of oil price in both trade and public finance.[28]

Figure 3.5. Impulse response for the model with TB and FB





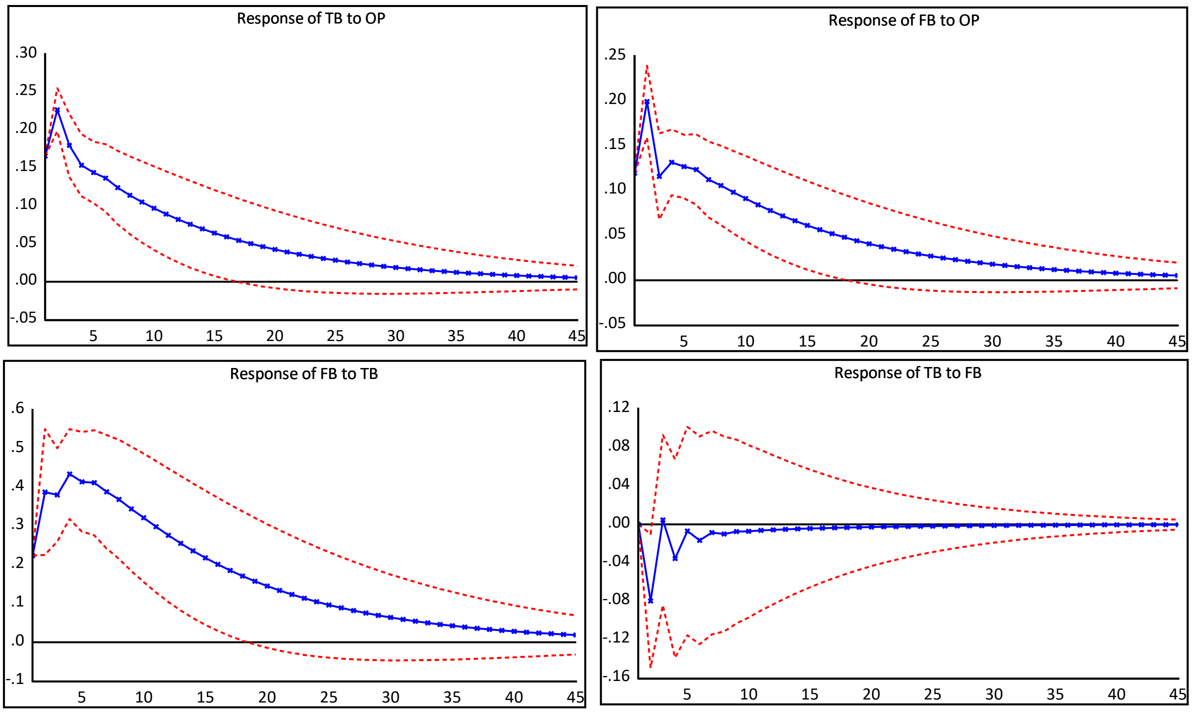
[28] We test the previous model with order $y_t = [TB, FB]'$, for robustness, we test the model with different order $y_t = [FB, TB]'$. The results from impulse response function are in Appendix 3.F, and it still supports the proposition that the effect of TB on FB is large and significant.

Next, we include OP with TB and FB, where we consider the OP as the link between TB and FB for the Omani economy. As illustrated in Figure 3.6, both TB and FB respond positively and highly to a positive OP shock. It confirms the importance of OP for both variables, while the response of TB is higher compared to the response of FB. The significant response on both variables tapers off after the 15th quarter. A similar outcome has been observed in other oil-dependent economies such as Nigeria (Chuku et al., 2011; Akanbi, 2015; Amaghionyeodiwe & Akinyemi, 2015). The positive balance in the current account is attributed to crude-oil exports, and the positive fiscal balance is attributed to oil revenue received by the government.

The FB responds positively and statistically significant to a TB shock, increasing immediately to 0.20 and peaking around 0.40 in the 5th quarter turns to insignificant around the 15th quarter. In contrast, the response of the TB to FB is insignificant.

As we notice that by adding the OP variable to the model specification, the TB and FB are statistically significant affected by OP shocks. The response of FB to TB is still significant in both cases, but the strength decreased by adding OP to the model. While the FB shock almost has no significant impact on TB in both cases. This finding supports the proposition of impact running from TB to FB.[29]

Figure 3.6. Impulse response for the model with OP, TB, FB



[29] Appendix 3.G used MIDAS-VAR from EViews 11, and the results support this finding.

We further examine the impact of oil price volatility (OP_V) on TB and FB by replacing oil price volatility for the oil price. Oil price volatility is the degree of variation of oil price series over time, measured by the standard deviation of each three months of the oil price.[30] This captures the concern over the effects of increasing oil price volatility in the last two decades (Baumeister & Peersman, 2013). Moreover, oil price volatility has an impact on fiscal and external balances in oil-exporting countries due to higher interest burdens, revaluation of foreign debt, and financial sector stresses (IMF, 2019). Further, commodity price volatilities are considered as a channel for resource curse, causing economic uncertainty and delays in budget stability (Majumder et al., 2020).

The reason that oil prices are volatile is that the natural resource supply has low price elasticity (Hausmann & Rigobon, 2003). Thus, an increase in oil price volatility in the short run could be due to steeper oil supply and demand curves. Consequently, any possible surplus or shortage in oil supply or oil demand creates a price jump, and this largely explains the high oil price volatility.[31]

While TB and FB respond positively to one standard deviation positive OP shock, they respond negatively to a positive OP_V shock as shown in Figure 3.7.[32] Contrary to the model specification with OP, where TB responds higher than FB to OP shock, in the current case, FB responds higher than TB to OP_V shock. This implies FB is more endogenous, and thus the Omani economy is able to adjust the fiscal policy easily and quickly due to oil price fluctuations compared to TB, which is largely influenced by exogenous variables. The responses between TB and FB are consistent with their responses in the model specification with OP, though the response of FB to TB is higher in this case (0.2 with OP compared to 0.5 with OP_V). The response of TB to FB is small and statistically insignificant.

Another plausible reason for the lower response of TB to OP_V compared to FB's response is that Oman depends on short future oil contracts. For instance, in August 2020, the market knew that the October price for the Oman crude oil will be around 44.00 US$/BBL.[33] This explains why the oil price in the first three months of 2020 was 62.80 US$/BBL, 65.50 US$/BBL, 64.90 US$/BBL, respectively, as the deal was done in late 2019. Later, consistent with the global economic slowdown, the oil price declined to 54.60 US$/BBL in April, 34.90 US$/BBL in May, and 23.70 US$/BBL in June.[34] As oil prices remain extremely volatile, the crude oil volatility index rose to its highest value on record in March 2020 (OPEC, 2020). The spot market deals are affected more by speculative activities and

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[30] Aghion et al. (2009) use standard deviation to calculate exchange rate volatility, Arezki et al. (2014) used it to calculate exchange rate volatility and gold price volatility and Mondal and Khanam (2018) apply it to calculate household consumption volatility.

[31] For example, given that oil production volatility is low, as the oil producer could not increase their supply immediately responding to demand increases (Kilian, 2009; Baumeister & Peersman, 2013).

[32] In chapter 2, we found the government revenue respond positively to a positive oil shock and government spending responds insignificant, compared to that both respond negatively to a positive oil price volatility shock.

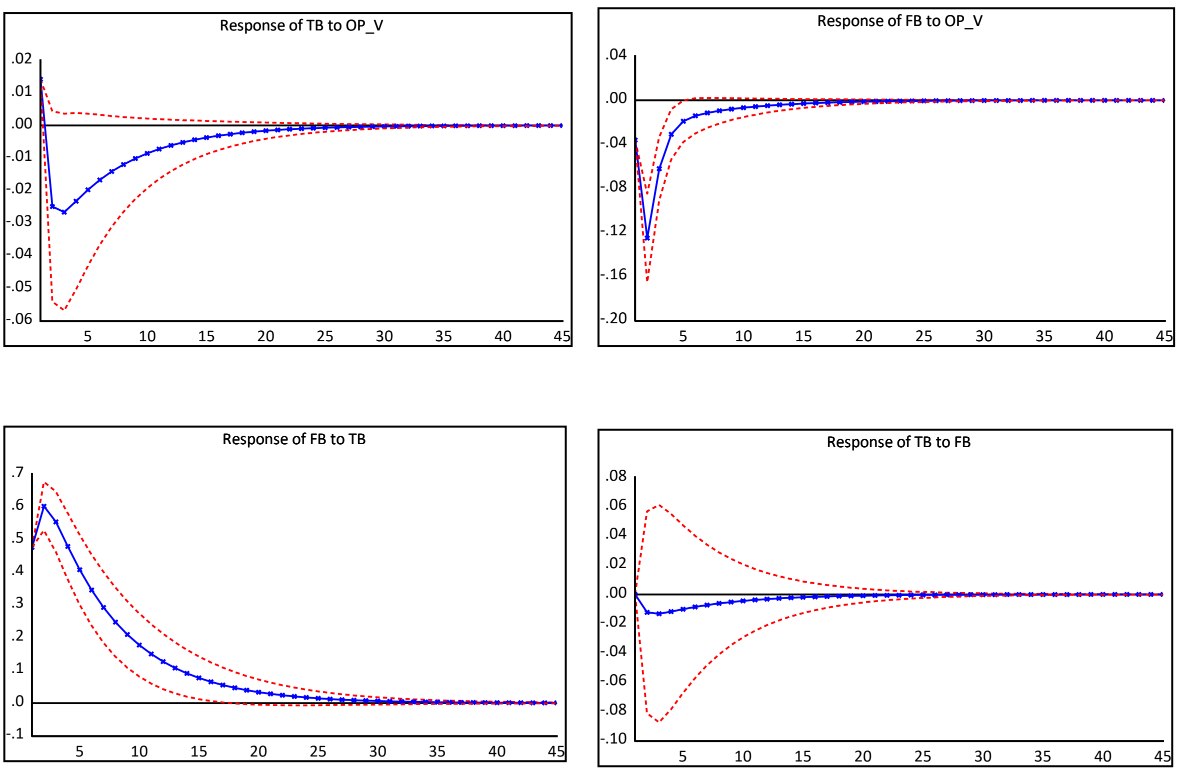
[33] https://www.atheer.om/

[34] The oil price is from a monthly bulletin published by NCSI and publicly available on https://www.ncsi.gov.om/.

inventory practice (Baumeister & Peersman, 2013). The crude oil spot prices dropped by more than futures contract as the physical market has been hit by a large oil supply glut and accumulation of unsold cargoes (OPEC, 2020). By contrast, when selling oil futures contracts as in Oman's case, oil producers became less responsive to oil price changes because the physical sales of crude oil are hedged (Baumeister & Peersman, 2013).

On the fiscal balance side, for example, the 2020 government public budget was planned on the assumption that oil price will be 58.00 US$/BBL. Therefore, when oil prices collapsed due to low demand caused by the COVID-19 pandemic and global economic slowdown, the government responded promptly by cutting 5.00% of the government budget, and then reduced the development budget by 10.00%. While it is a good sign that the government has the ability to adjust to oil price declines, it is also a sign of uncertainty due to commodity price volatility. This explains the differences in the responses of FB to OP shocks and OP_V shocks. In addition, any improvement in oil price leads to a positive impact on internal and external balance, whereas the price volatility causes more uncertainties. The commodity price volatility decreases the government fiscal balance for commodity-exporting countries (Majumder, 2019).

Figure 3.7. Impulse response for the model with OP_V, TB, and FB



3.4.4.3 Historical decomposition

The SVAR model is used to decompose the TB and FB into components shocks. Thus, this sub-section presents a historical decomposition analysis of the contributions of OP shocks, TB shocks, and FB shocks in TB and FB movement over the study period from 1989Q4 to 2017Q4 as illustrated in Figure 3.8 and Figure 3.9, respectively. The historical decomposition gives an insight into the importance of a specific variable shock on a variable at each time point, Thus allows for contribution assessment of each shock to the variable over time (Dungey, Osborn, et al., 2014; Raghavan, 2020).

Oil, like other industrial commodities, depends on supply and demand as a consequence of global business cycle fluctuations (Kilian, 2009; Baumeister & Kilian, 2016). Moreover, issues such as geopolitical tensions in oil-producing countries may disrupt crude oil production, changes in crude oil demand associated with the global business cycle, the discovery of new fields or improvement in oil-extracting technology, and expectations about future shortfalls of oil supply relative to oil demand lead to different dynamic effects on oil price (Raghavan, 2020).

A quick glance at Figure 3.8 and 3.9 reveal same historical decomposition trend of TB and FB due to the high contribution of OP in both variables. Furthermore, the former contributes significantly to the latter too. As expected, the variation in TB is attributed mostly to the disturbance in TB itself and OP, while the FB shock has very limited contribution, as shown in Figure 3.8. By comparing three time points of oil price decline, such as during the AFC period, GFC, and the recent decline in oil price between 2014 and 2017, the OP shock contributes less during GFC. The variation in FB attributed to the OP shock, TB shock, and its own shock are equally important as Figure 3.9 illustrates, attributing to a high dependence of fiscal policy in Oman on petroleum exports revenue.

Oman's General Reserve Fund was established by the government to manage and invest the surplus revenue from petroleum resources, to diversify government income, and to secure future generations. Giving the significant importance of oil price in trade and fiscal stance in Oman pose challenges for the policymakers. Indeed, high government spending and low realized oil price in specific times, escalated the public debt and the debt service costs.

Figure 3.8. Historical decomposition for TB

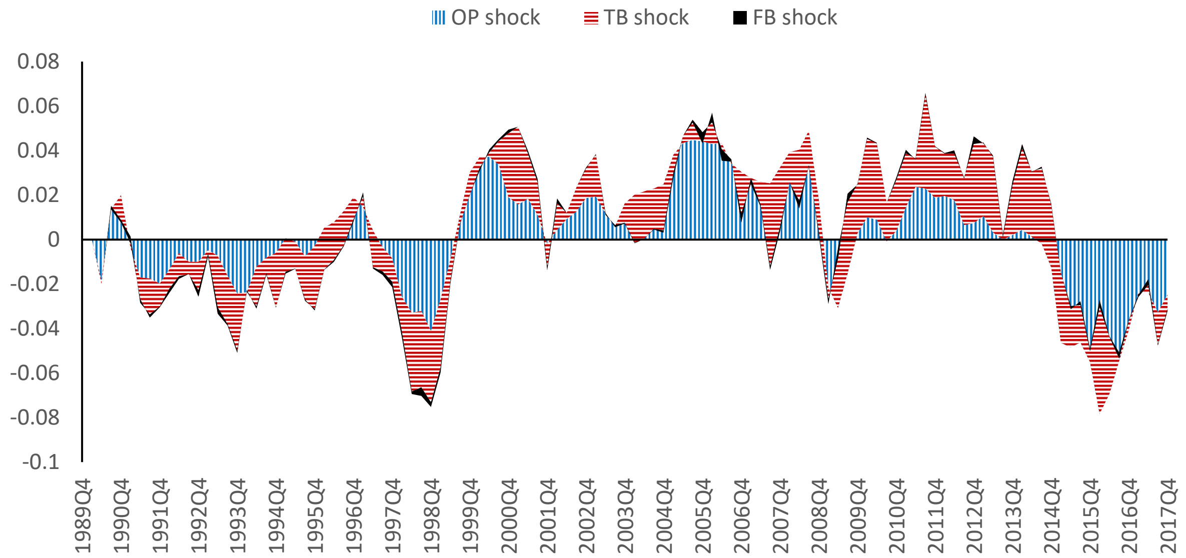
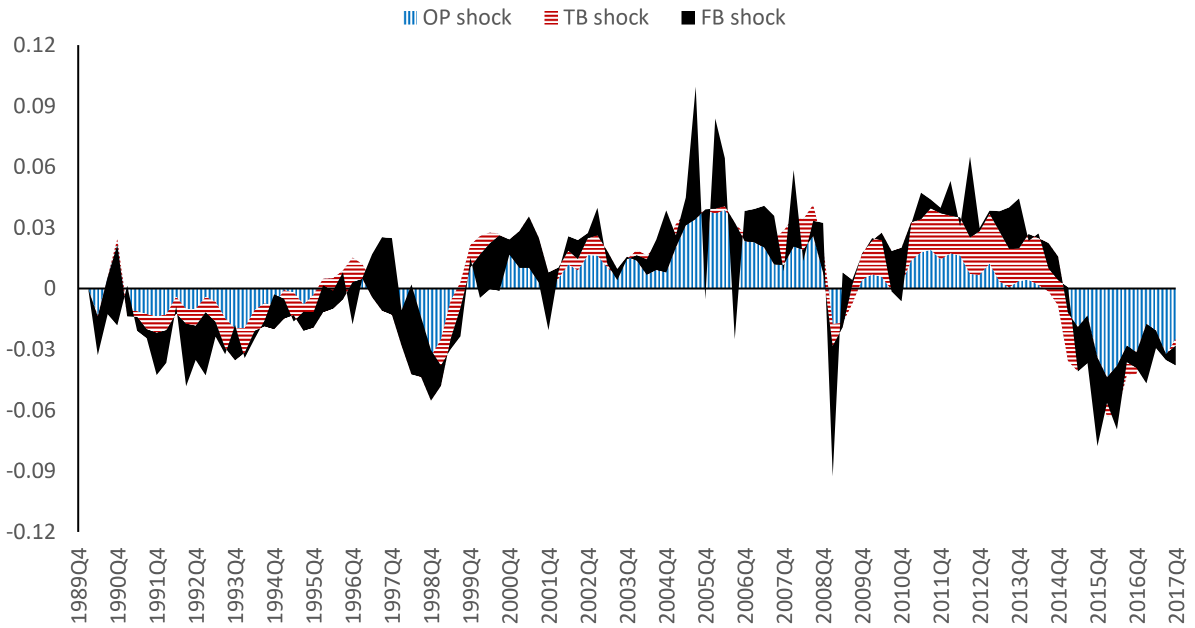


Figure 3.9. Historical decomposition for FB



3.4.4.4 Change in the responses over time

As mentioned before that the period under consideration include demand-driven high oil prices and demand-driven low oil prices. Thus, after investigating the twin deficit phenomena in the

Omani economy under the full period, now we will assess the twin deficit under three different sub-periods as described in Table 3.7.[35]

Table 3.7. Breakdown of the study period

Description	Period
Full period	1989Q4 – 2017Q4
1st sub-period includes the 1990 Kuwait invasion	1989Q4 – 1996Q4
2nd sub-period includes Kuwait invasion and the 1998 AFC	1989Q4 – 2006Q4
3rd sub-period includes Kuwait invasion, AFC and the 2008 GFC	1989Q4 – 2013Q4

Figures 3.10 and 3.11 show the responses of TB and FB to OP shocks respectively under the different sub-periods described above and the results accord with our earlier results in Figure 3.6. Generally, TB responds higher than FB to positive OP shocks. As mentioned before, this could be because TB is more exogenous compared to FB, as the government has the capacity to smooth the expenditure using domestic and international debt and reserve fund to mitigate the impact of oil prices swing.

Figure 3.10 shows the response of TB to OP shocks under the sub-periods mentioned above, the first sub-period (1989Q4 to 1996Q4) has the lowest impact compared to the latter three time periods. This sub-period includes a high oil price driven by a precautionary demand shock caused by the invasion of Kuwait in the third quarter of 1990, and it has a short-lived shock as shown in Figure 3.4 above.

In the second sub-period (1989Q4-2006Q4), the response of TB to OP shock is higher compared to the other two sub-period and the full period. The results can be explained by the fact that the Asian market is the main destination for the Omani oil. Between 1980th and 2000, Japan was the main export destination for Omani oil; then China took over as the main export destination. In 2018 China imported 83.10% of the Omani oil, followed by India and Japan for 7.60% and 5.80% respectively (NCSI, 2019). This may also explain the steady decrease in the response of TB to OP shocks in the third sub-period (1989Q4 to 2013Q4) which includes the GFC that mainly affected the US and Europe. In contrast, the response of TB to OP shock using the full period started with an even lower point among the four times, but it decreases gradually with long-lived impact compared to two previous sub-periods that includes low oil price periods driven by negative demand shock.

Figure 3.11 illustrates the impulse response function of FB to OP shocks; in the first sub-period, there is a steady decline of FB response to an OP positive shock. In the latter two sub-periods which includes AFC and GFC respectively, the response of FB to OP shock both have the same pattern, though the responses in the first four quarters are slightly different. The full period has the highest

[35] Due to limited time-series data (1989Q4 -2017Q4), it is not possible to divide the period into completely different sub-periods.

response of FB to OP shocks, and the finding is likely to be related to the steady increase in government spending over the years coupled with fluctuations of government revenue which will is shown in Figure 3.15 later.

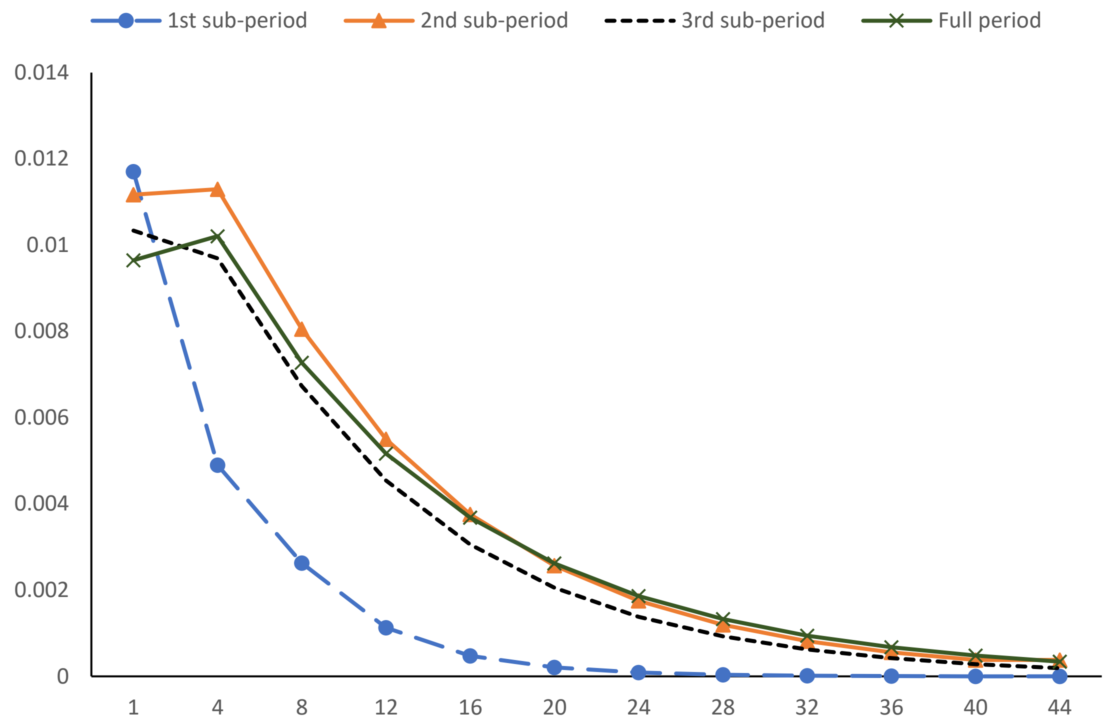
Moving forward to Figures 3.12 and 3.13 that present the responses of TB and FB to shocks in each other under the three different sub-periods described above. Consistent with the previous results, the responses of FB to TB shocks is higher than the responses of TB to FB shocks in all sub-periods.

TB responds positively to a positive FB shock in the first sub-period and responds negatively in the latter two sub-periods and the full period as shown in Figure 3.12. TB responds with the same force but with opposite sign in first and third sub-periods. It responds negatively with less force in the second sub-periods and the full period. Compared to that, FB responds positively to positive TB shocks in all three sub-period and the full period as Figure 3.13 illustrates. The responses of FB are gradually increasing as we move from one sub-period to the subsequent sub-periods. This observed increase of FB responses could be attributed to an increasing influence of TB on the fiscal measure over time.

These differences in response between TB and FB can be explained by the fact that the TB is more exogenous compared to the FB. TB is influenced by oil exports, which move with the global trend. For example, the first sub-period includes high oil price driven by a precautionary demand shock associated with the Kuwait invasion; by contrast, the latter two sub-periods include low realized oil price driven by low demand. Whereas the FB can be relatively managed internally by the government policies with less direct influence from global oil price trends.

The results from the impulse response function reveal that TB and FB responses are not the same under different sub-periods. The purpose of dividing the study period into various sub-periods is to evaluate the twin deficit phenomena through time. Therefore, the historical decomposition and variance decomposition will allow us to contrast the TDH under different sub-periods, which provides valuable insight into the twin deficit nexuses at different times.

Figure 3.10. Impulse response of TB to oil price at different times



Note: The responses are in the y-axis and time index (quarters) in the x-axis in all figures.

Figure 3.11. Impulse response of FB to OP shocks at different times

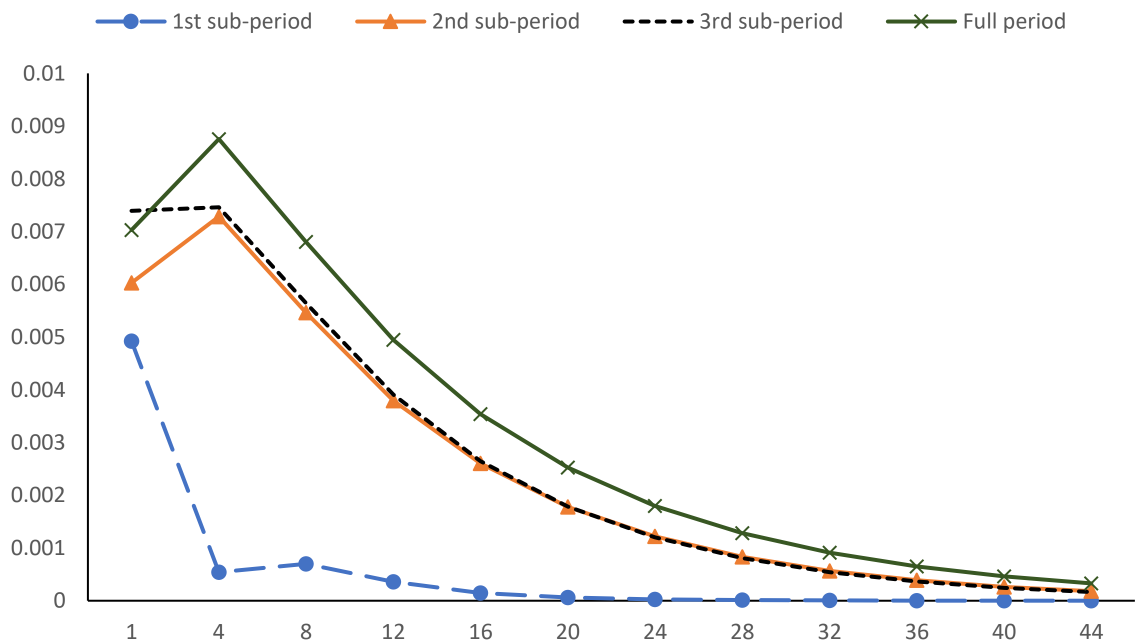


Figure 3.12. Impulse response of TB to FB shocks at different times

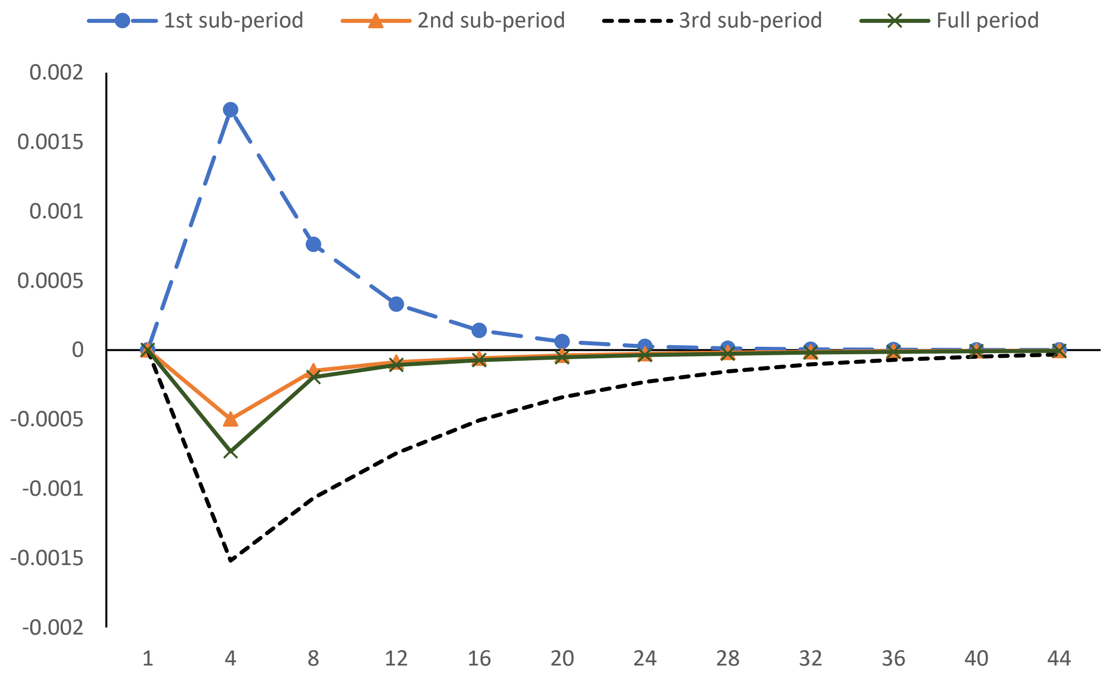
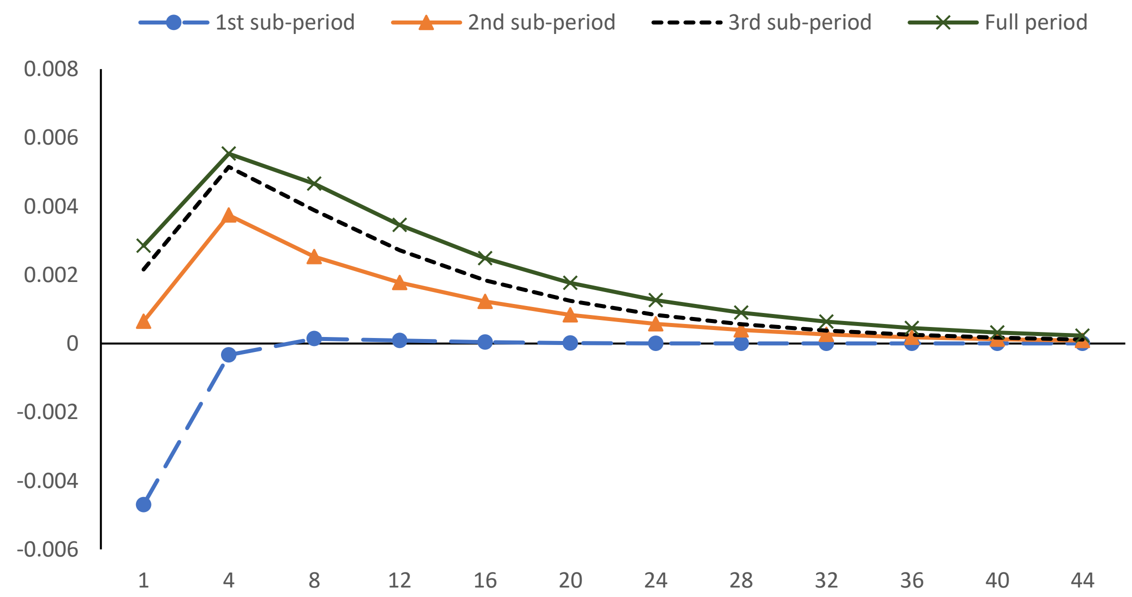


Figure 3.13. Impulse response of FB to TB shocks at different times



3.4.4.5 Forecasting error variance decomposition

Having discussed the results of IRF in the previous sections, now we present the results of FEVD, and the results set out in Table 3.8. The TB shocks play an important role in explaining the variance in FB; starting by 12.42% in the 1st quarter and increased to 46.78% in the 20th quarter. Compared to that, the contribution of FB in TB variance is lower, ranging between 0.00 in the 1st quarter and increased to 2.84% only in the 20th quarter.[36]

Table 3.8. Forecast error variance decomposition for the model with TB and FB

	Variance Decomposition of TB		Variance Decomposition of FB	
Horizon (Q)	TB	FB	TB	FB
1	100.00	0.00	12.42	87.57
4	99.61	0.38	37.02	62.97
20	97.15	2.84	46.78	53.21
45	97.08	2.91	46.89	53.11

Extending the model by adding OP; the result in Table 3.9 shows that OP shock plays a vital role in explaining the variance in TB and FB. It explains between 35.71% in the 1st quarter and 58.51% in the 20th quarter for the former and about 9.39% in the 1st quarter and increased to 44.04% in the 20th quarter for the latter. For the contribution of FB and TB on each other, in general, the contribution of TB in FB variance is much higher compared to the contribution of FB in TB. The FB shock contributes only between 0.00% in the 1st quarter and increased to 0.25% in the 20th quarter to the variance in TB. In comparison, TB shock contributes between 1.63% and 20.75% to the variance in FB in the 1st quarter and the 20th quarter, respectively.[37]

Table 3.9. Forecast error variance decomposition for the model with OP, TB, FB.

Horizon (Q)	Variance Decomposition of TB			Variance Decomposition of FB		
	OP	TB	FB	OP	TB	FB
1	35.71	64.29	0.00	9.39	1.63	88.99
4	56.15	43.42	0.43	31.91	9.94	58.14
20	58.51	41.24	0.25	44.04	20.75	35.20
45	58.61	41.15	0.24	44.60	21.34	34.06

[36] For a robustness test, we change the order of the variables in the model to start with FB then TB, $y_t = [FB, TB]'$, as appendix 3.F shows the contribution of TB shocks in FB variance remains higher than the contribution of FB shocks in TB variance, up to 22.45% for the former and only 20.17% for the latter in quarter 20th which confirms our assumption that the direction of the relationship runs from TB to FB.

[37] As we did before in IRF, we replace OP shocks for OP_V shocks. The results in Appendix 3.H show that OP_V shocks explain less of the variance in both TB and FB compared to OP shocks.

Next step, we compare the results of forecast error variance decompositions across the three sub-periods and the full period, and Table 3.10 summarises the results. Overall, OP shocks play a vital role in TB variance compared to in FB variance, by more than 50% in the former and less than 50% in the latter through all periods.

The contribution of OP shocks in TB variance in the first two sub-periods was high, up to 78% in the 20th quarter, then it decreased to around 65% in the last sub-period and the full period. This high contribution of OP shock in the variance of TB is attributed to the high proportion of petroleum in merchandise exports value in the oil-based economy such as Oman.

By contrast, the contribution of OP shocks in the variance in FB gradually increased, i.e. from 28.14% to 44.65%, 43.58%, and 49.13% in subsequent periods in the 20th quarter. This may indicate that the ability of the government to smooth spending in challenging times is declining over time. The fiscal space has tightened for Oman now due to elevating public debt, increasing fiscal deficits as shown in Figure 3.1 and a steady surge of fiscal breakeven oil price as shown in Figure 3.2.

Regarding the trade balance and fiscal balance nexus, the TB shock contributes higher to the FB variance, compared to the contribution of FB to the TB variance in all three sub-periods and the full period. The contribution of TB to the FB increased gradually, i.e. from 8.78% to 8.84%, 16.19%, and 18.61% in the 20th quarter. While the contribution of FB to the TB in the 20th quarter decreased over time from 2.88%, 0.09%, 1.10% and 0.22% over the three sub-periods and the full period.

Table 3.10. Forecast error variance decomposition for the model with OP, TB, and FB with different periods

	1st (1989Q4-1996Q4)			2nd (1989Q4-2006Q4)			3rd (1989Q4-2013Q4)			Full (1989Q4-2017Q4)		
Variance Decomposition of TB												
Horizon (Q)	OP	TB	FB	OP	TB	FB	OP	TB	FB	OP	TB	FB
1	66.10	33.91	0.00	52.39	47.61	0.00	41.80	58.20	0.00	36.44	63.56	0.00
4	76.69	21.03	2.28	75.50	24.36	0.14	62.49	36.77	0.74	60.18	39.44	0.39
20	78.37	18.74	2.88	78.45	21.47	0.09	64.14	34.77	1.10	63.35	36.43	0.22
45	78.37	18.74	2.89	78.52	21.39	0.09	64.17	34.71	1.11	63.47	36.32	0.21
Variance Decomposition of FB												
Horizon (Q)	OP	TB	FB	OP	TB	FB	OP	TB	FB	OP	TB	FB
1	12.16	11.06	76.78	7.66	0.09	92.25	10.23	0.88	88.89	9.82	1.62	88.56
4	25.92	9.09	64.99	27.53	5.19	67.27	31.25	8.56	60.19	35.84	9.37	54.79
20	28.14	8.78	63.07	44.65	8.84	46.51	43.58	16.19	40.23	49.13	18.61	32.26
45	28.15	8.78	63.07	45.26	8.99	45.75	43.95	16.45	39.60	49.68	19.05	31.27

3.5 Twin deficit in the long run

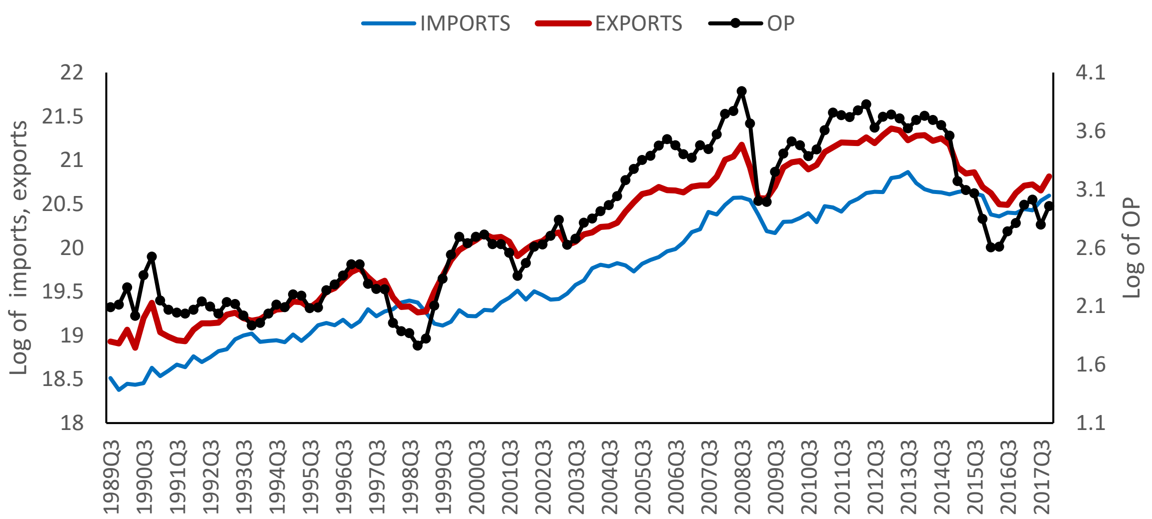
In this section, we will examine the long-run relationship between oil price, exports, imports, government revenue, and government expenditure using the Johansen cointegration test and structural vector error correction (SVECM) model.

3.5.1 Data and methodology

We test the long-run relationship between oil price, exports, imports, government revenue, and government expenditure. The variables are in monthly frequency, constant, and in logarithm form, and data description details are Appendix 3.C. The first step is to test the data for stationarity using three different unit root tests: - Augmented Dickey-Fuller (ADF), Philips –Perron (PP), and Kwiatkowski-Philips-Schmid-Shin (KPSS). The I(1) variables can be used to perform the cointegration test and then proceed with an vector error correction (VECM) model. Appendix 3.E shows the unit root test results are not consistent across the three tests if the variables are expressed in level and integrated of order I(1) and the variables are stationary in the first difference.

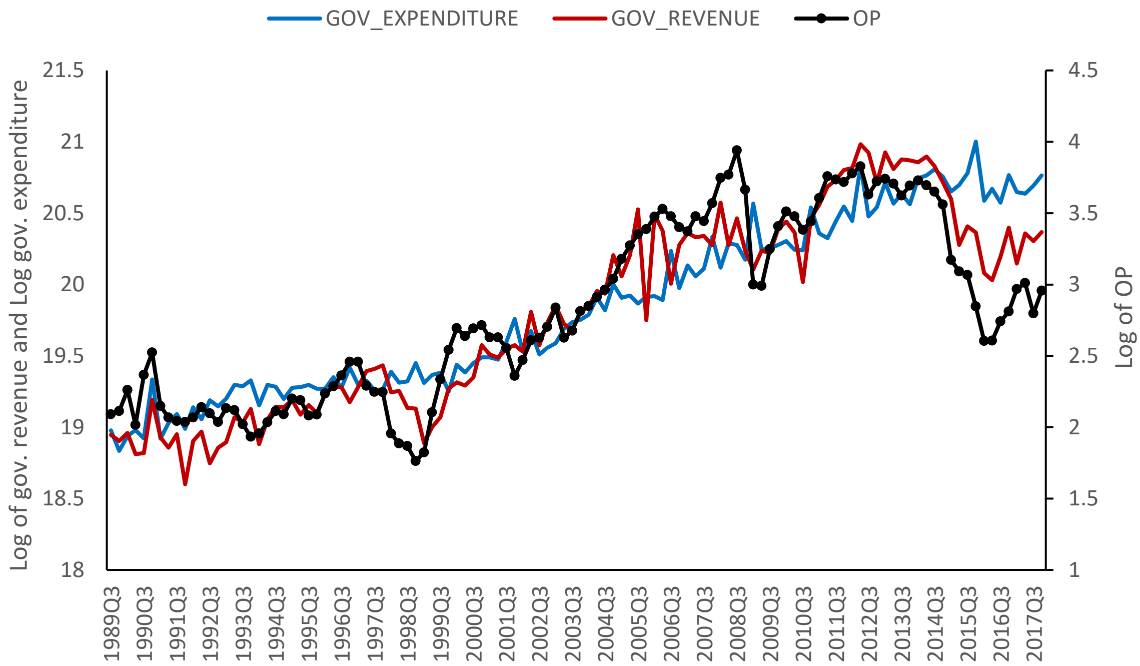
Due to the high contribution of oil in exports, Figure 3.14 shows a co-movement between the three variables: oil price, exports, and imports, as the oil price rises the exports value increases and influence the domestic spending and imports. Likewise, Figure 3.15 shows a clear co-movement between oil price, government revenue, and government expenditure, as oil price rises the government revenue increase and influence the government expenditure (Merza et al., 2012; Akanbi, 2015).

Figure 3.14. Exports, imports and oil price



Source: Different issues of the monthly statistical bulletin, NCSI.

Figure 3.15. Government expenditure, government revenue, and oil price



Source: Different issues of the monthly statistical bulletin, NCSI.

3.5.1.1 The VECM model

The next step is to test variables for long-run relationship. There is an expectation that the variables are cointegrated and there is a stationary linear combination among them. In this case, if we have K-dimensional VAR(p) process, without deterministic terms for ease of exposition

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + u_t$$

Subtracting y_{t-1} on both sides of the equation and rearranging give us the VECM:

$$\Delta y_t = \Pi \mathrm{y}_{t-1} + \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{p-1} \Delta y_{t-p+1} + u_t \quad (3.8)$$

Where

$$\Pi = -(I_K - A_1 - \cdots - A_p)$$

And

$$\Gamma_i = -(A_{i+1} + \cdots + A_p), \qquad i = 1, \ldots, p-1$$

In (3.8) the y_{t-1} is nonstationary variable, since both sides should be stationary it requires Πy_{t-1} to be I(0).

The variables have unit root individually $\det(I_K - A_1 z - \cdots - A_p z^p) = 0$. The matrix Π is singular if the $z = 1$, but if we have a matrix with rank r. So, there are r linearly independent cointegrating relationships. Therefore, $K \times K$ matrix of rank r will produce two $K \times r$ matrices of full column rank like α and β, $\Pi = \alpha\beta'$.

$$\Delta y_t = \alpha\beta' y_{t-1} + \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{p-1} \Delta y_{t-p+1} + u_t$$

$\Pi = \alpha\beta'$ the β is the matrix of long-run co-integration relationship (cointegrating matrix) and α is the matrix of adjustment coefficients for I(1) variables (loading matrix). It called VECM because it includes the lagged error correction (EC) term $\alpha\beta' y_{t-1}$. For model with n blocks or variables and h_i series in the jth block as $j = 1,2, \dots, n$ and the dimension of Y_t is $m \times 1$ as $m = \sum_j^n hj$ and

$$Y_t = \begin{bmatrix} Y_{1,t} \\ Y_{2,t} \\ \vdots \\ . \\ Y_{n,t} \end{bmatrix}$$

In our SVECM model, there are five variables $Y_t = [OP_t, EP_t, GR_t, GE_t, IM_t]'$. Where OP is the oil price, EP is the exports, GR is the government revenue, GE is the government expenditure, and IM is the imports. Figures 3.14 and 3.15 above demonstrated that there is a common trend among the five variables. Oil price is the most exogenous which is influenced by international supply and demand, and it has a crucial impact on the Omani exports since up to 60.00% of the exports is petroleum merchandise. This oil revenue is managed by the government and is considered as main government income contributes up to 70.00% on average. Therefore, it influences the government expenditure as the annual government expenditure planned based on predicted government revenue which is from oil mostly, finally both government and public spending influence the imports and its trends with exports as Appendix 3.A shows.

3.5.2 Empirical results and discussion

This sub-section presents the long-run relationship between the five variables. We test the cointegration relationship first using the Johansen test, and then discuss the two cointegration equations and illustrate the IFR.

3.5.2.1 Cointegration and long-run relationship

Figure 3.14 shows a common upward trend among oil prices, exports, and imports. Similarly, Figure 3.15 shows a common trend among oil price, government revenue, and government expenditure. Thus, we expect a long-run relationship exists between the five variables. Moreover, due to the high contribution of petroleum in exports and government revenue, it can be clearly seen there is a close co-movement between oil price and exports in the first figure and between oil price and government revenue in the second figure.

As mentioned above the unit root tests indicate the variables are integrated of first-order I(1), so, the next step is to test for long-run cointegration relationship. The Johansen cointegration test is employed to examine if the variables are simultaneously cointegrated. Following Akanbi (2015), we use a model that allows for a linear deterministic trend in data, constant, and trend in the cointegration equation and no constant in VAR. According to the results from Trace test and Maximum eigenvalue test, there are two cointegration relationships between the five variables at the 5% significant level as demonstrated in Table 3.11.[38]

Table 3.11. The cointegration tests

Trace test				Maximum eigenvalue test			
H_0	H_1	Trace statistic	Critical value	H_0	H_1	Max-eigen statistic	Critical value
$r = 0$	$r \geq 1$	132.34*	88.80	$r = 0$	$r \geq 1$	60.19*	38.33
$r \leq 1$	$r \geq 2$	72.16*	63.87	$r \leq 1$	$r \geq 2$	39.21*	32.12
$r \leq 2$	$r \geq 3$	32.95	42.92	$r \leq 2$	$r \geq 3$	20.94	25.82

* Denotes rejection of the null hypothesis at the 5% level

Government expenditure and imports play a vital role in fiscal balance and trade balance, respectively; thus, the cointegration vectors normalized on government expenditure for the first equation, and on imports for the second equation. Moreover, to fully identify all cointegration vectors, the coefficient of imports is restricted to 0 in the first equation, while the government revenue coefficient is restricted to 0 in the second equation.

$$GE_t = -0.16OP_t - 0.66EP_t + 1.20GR_t + ect_t$$
$$[0.90] \qquad [2.77] \qquad [-8.27]$$
$$IM_t = -1.37OP_t + 1.87EP_t + 3.16GE_t + ect_t$$
$$[3.44] \quad [-3.55] \quad [-8.29]$$

[38] Akanbi (2015) found three cointegration relationship for Nigeria among government budget surplus, government expenditure, real exchange rate, money supply growth and GDP growth. Hamdi and Sbia (2013) found one long-run relationship between oil revenue, government expenditure and GDP for Bahrain. Eltony and Al-Awadi (2001) found four long-run relationship between oil price, oil revenue, government expenditure (development/ current), CPI, money demand and imports for Kuwait.

Where OP is the oil price, GE is the government expenditure, GR is the government revenue, EP is the exports and IM is the imports, and t-statistics values are in parenthesis.[39]

Consistent with expectations, for the first equation, there is a significant positive long-run relationship between government expenditure and government revenue. In contrast, a significant negative long-run relationship with exports, and insignificant negative relationship with the oil price. These results may be explained by the fact that annual government expenditure is based on the predicted government revenue. Whereas oil and exports, which is dominated by petroleum exports, have an indirect impact on government expenditure through their contribution to government revenue.

In the second equation, imports has a significant positive long-run relationship with exports and government expenditure and a significant negative long-run relationship with oil prices. The positive relationship between imports and exports can be explained by two reasons. Firstly, the contribution of re-exports in exports is considerable, about 20.00%, 17.00%, 11.00% in 2016, 2017, and 2018, respectively (NCSI, 2019).[40] Secondly, as exports revenue increases, the government and household spending on imports increases. High percentage of people are public employees, and public employees' salaries account for 73.50% of the current government spending (NCSI, 2019). This second reason is a possible explanation also for the positive long-run relationship between imports and government expenditure since Oman depends largely on import for consumption and investment products, food, and increasing demand for services (CBO, 2019).

The relationship between imports and re-exports may justify the negative long-run relationship between imports and oil price. When oil price falls, the value of petroleum exports decline, and the value of re-exports as a percentage of exports increases. For example, in 2016 the oil price was 40.10 US$/BBL, and the contribution of re-exports in total exports was 20%. When oil price recovers and increases to 51.30 US$/BBL in 2017, the re-exports contribution decreased to 17%. It decreased more to 11% in 2018 when the oil price was 69.70 US$/BBL. Taking into consideration the petroleum exports in this last three years was 57%, 58%, and 66%, respectively and the exported quantity increase to cover the loss from the low realization of oil price (NCSI, 2019).

[39] The implied over-identification restrictions on the two co-integrating vectors as imposed above are easily accepted in an otherwise unrestricted VECM that employs lagged difference for all five I(1) variables with a p-value of greater than 0.05.

[40] In 2018, re-exports includes manufactured goods classified by material (22.4%), chemicals and their products(20.6%) and machinery and transport equipment (19.6%), and imports dominated by machinery and transport equipment (33.3%) and manufactured good (22.7%) (NCSI, 2019).

3.5.2.2 Impulse response function

Will examine the responses of government revenue, government expenditure, exports, and imports to a positive shock in all five variables in the model. The shock size is measured by one standard deviation of the orthogonal errors, the x-axis is the monthly time index, and the y-axis presents the response with a 68% confidence interval and giving a brief outcome in the coming paragraphs.

The results are similar to the results of the short-run analysis, where fiscal balance and trade balance respond positively and statistically significant to oil price shocks. In the long-run model, oil price shocks have a significant positive impact on government revenue, exports, and imports, and the highest responses are from government revenue and exports and the lowest from imports. In contrast, the response of government expenditure to oil price shocks is insignificant. This accords with results from other oil-dependent economies such as Nigeria where the exports and government income linked to oil revenue, with a long-run relationship between budget deficit and current account deficit (Amaghionyeodiwe & Akinyemi, 2015).

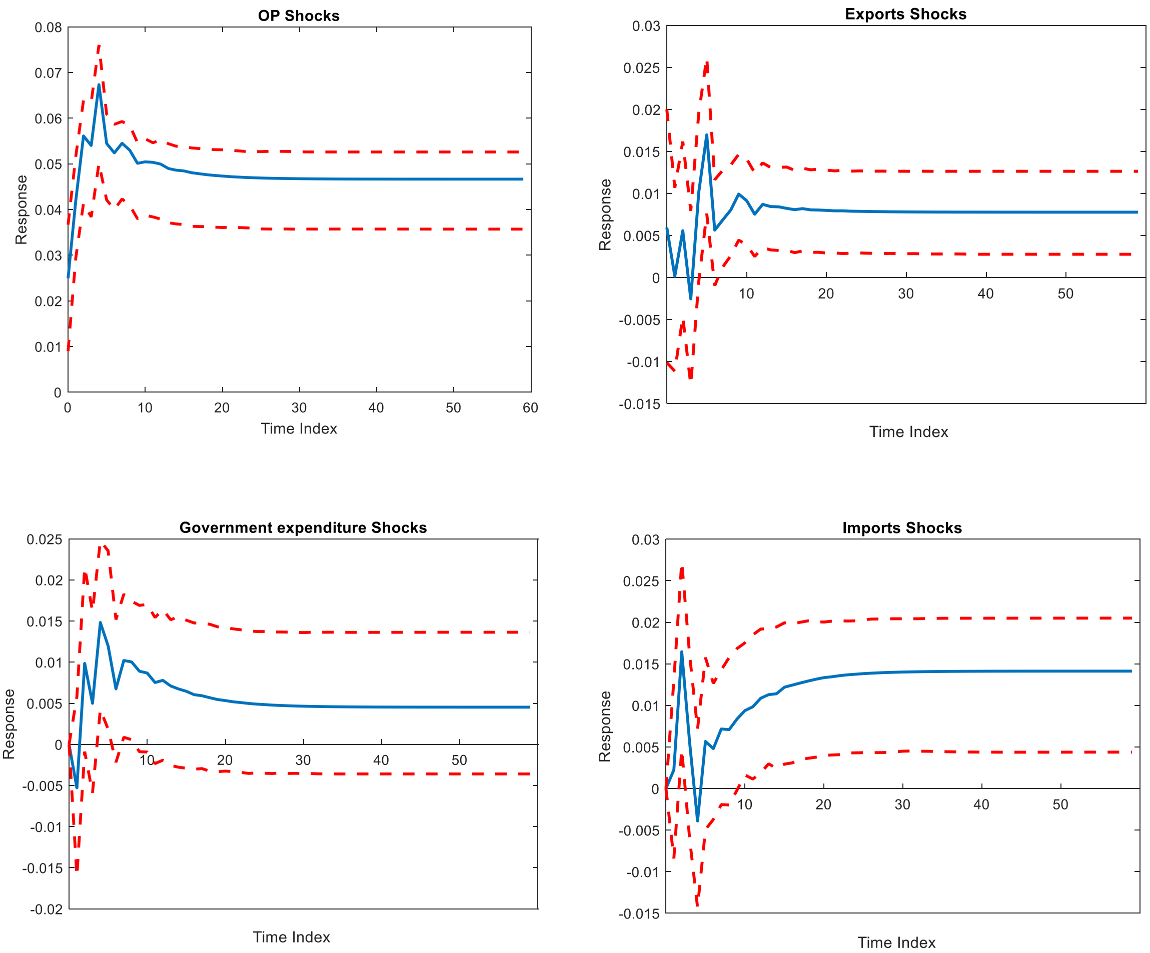
On the fiscal side, government expenditure responds statistically significant to government revenue shocks but not vice versa. In the same way, the imports responds statistically significant to exports shocks but not vice versa. Thus, there is a unidirectional impact on government revenue and exports toward government expenditure and imports.

Moving on to test the interaction between fiscal and trade balances, government revenue responds statistically significant to both exports and imports shocks. A possible explanation for this might be that petroleum exports and custom duties are sources of government income. Indeed, the introduction of ‘Bayan’ clearing system that facilitates the customs duties collection improves the custom duties contribution in government revenue (CBO, 2019).

While imports respond statistically significant to both government revenue and government expenditure; exports responds statistically insignificant to government revenue and government expenditure. These results corroborate the findings from the short-run examination that there are bidirectional responses between fiscal balance and trade balance but the response of former to latter is higher.

Figure 3.16 shows the impulse response of government revenue to oil price shocks, exports shocks, government expenditure shocks, and imports shocks. As expected, government revenue responds positively and statistically significant to oil price shocks. It also responds positively and statistically significant to exports and imports but lower compared to oil price shocks. In contrast, it responds positively but statistically insignificant to government expenditure shocks. The responses stabilised after ten months of fluctuations. These outcomes are in line with Granger causality test results in Appendix 3.I.

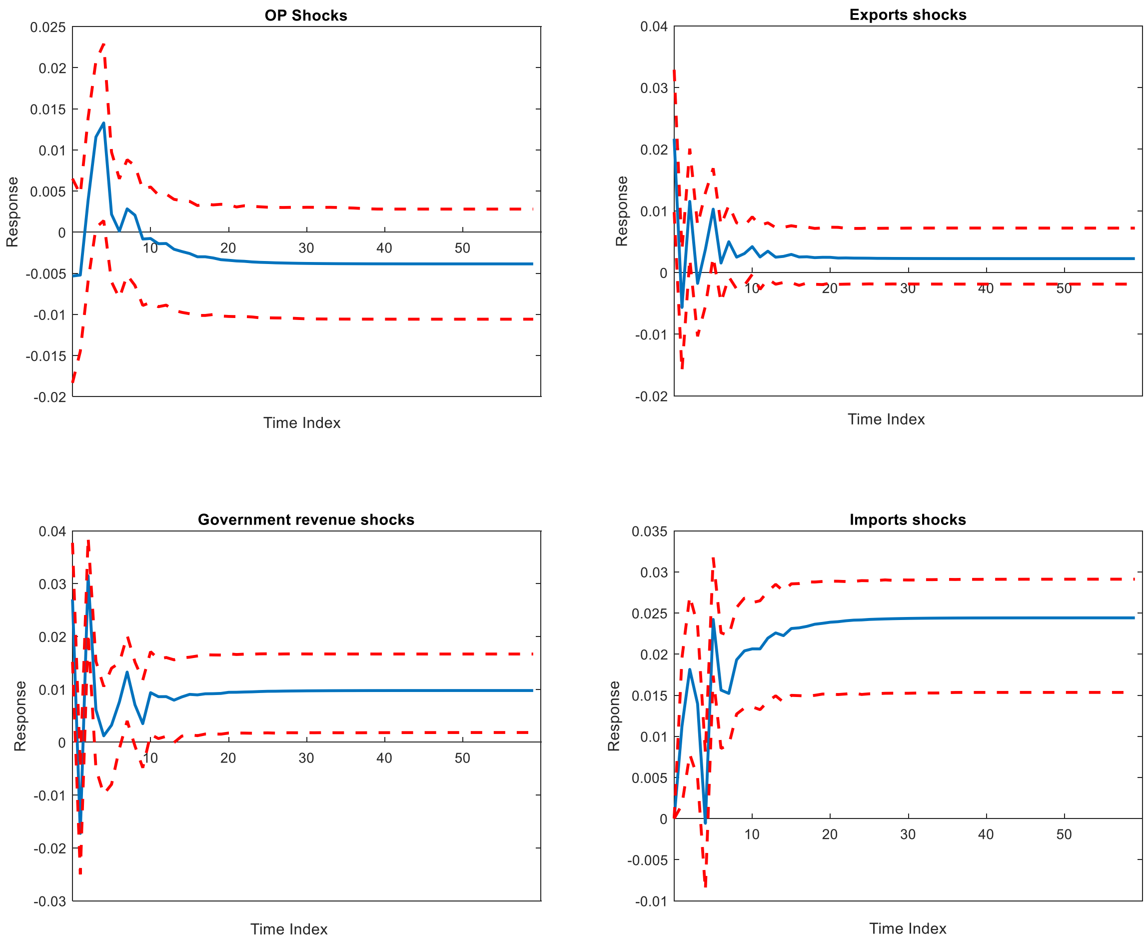
Figure 3.16. Impulse response of government revenue



The responses of government expenditure to one positive standard deviation shocks in oil price, exports, and government revenue and imports are presented in Figure 3.17. The responses of government expenditure fluctuate to all shocks in the first 10 months then stabilise. Government expenditure responds positively and statistically significant to government revenue, while it responds positively and insignificantly to oil price shocks and positive but slightly significant to exports shocks. This is an indicator that government spending is not adjusting to oil price swings, and therefore can lead to public debt accumulation. For example, in 2016 when the realised oil price was 40.1 US$/BBL, the fiscal breakeven oil price was 100 US$/BBL and the fiscal deficit as a percentage of GDP was 21%. The causality results are reported in Appendix 3.I appear to support this view, where the null hypothesis of government revenue does not Granger cause government expenditure is rejected, while the hypotheses oil prices or exports do not Granger cause government expenditure are not rejected.

The responses of government revenue and government expenditure to oil price shock are consistent with the results obtained from chapter 2. The insignificant impact of oil price shocks on government expenditure reflects the ability of the government to smooth spending. The government uses different ways, i.e. (i) fund the deficit using the reserve fund when the oil prices drop, (ii) fund through local and international debts, and (iii) isolating the impact of oil price increase using reserve fund, i.e. when oil price increases higher than the anticipated price for a specific five-development plan, the excess goes to the reserve fund.

Figure 3.17. Impulse response of government expenditure



Having discussed the responses of the fiscal variables, we will now move on to discuss the responses of the trade variables; exports, and imports to shocks in other variables in the model. As shown in Figure 3.18, exports respond positively and statistically significant to oil price shocks only. In contrast, the responses to imports shocks, government revenue shocks, and government expenditure shocks are not statistically significant.

Figure 3.18. Impulse response of exports

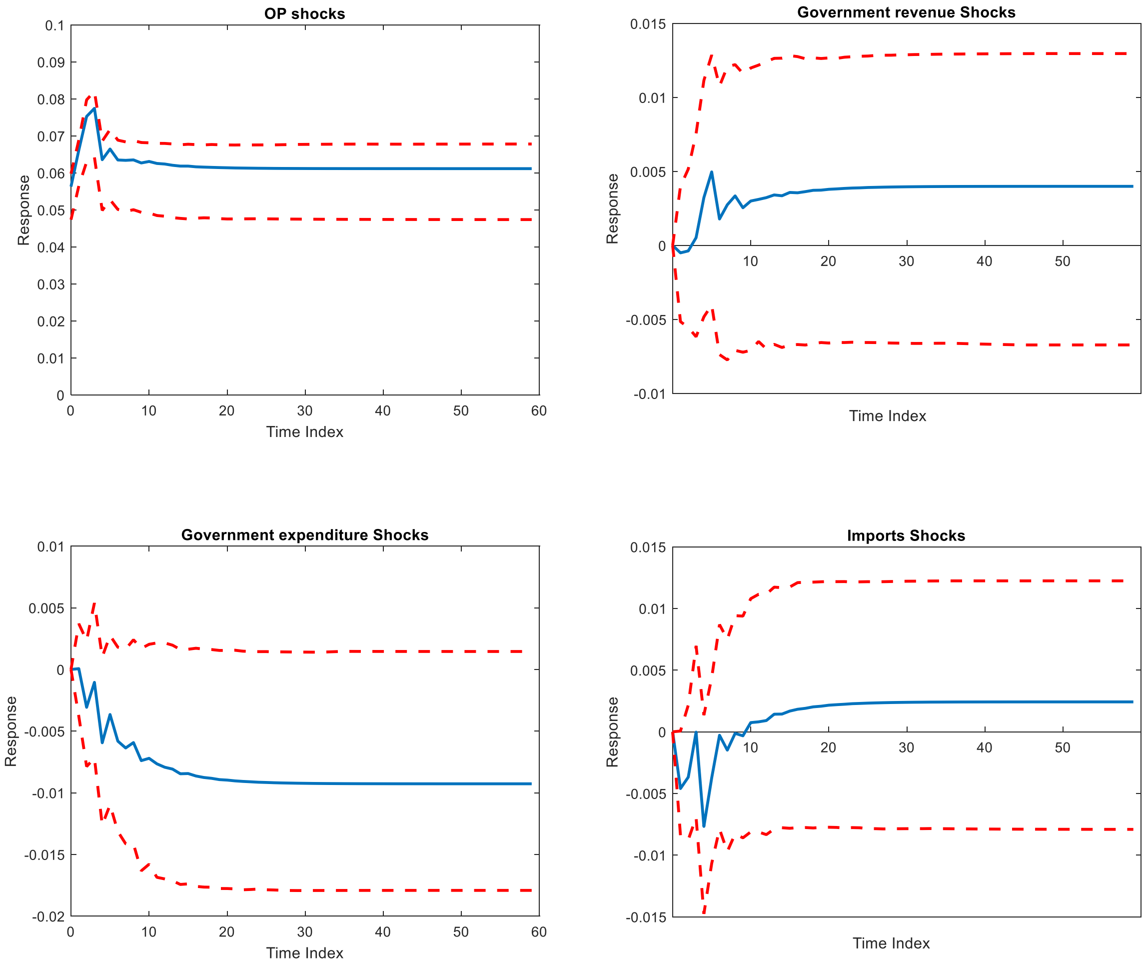
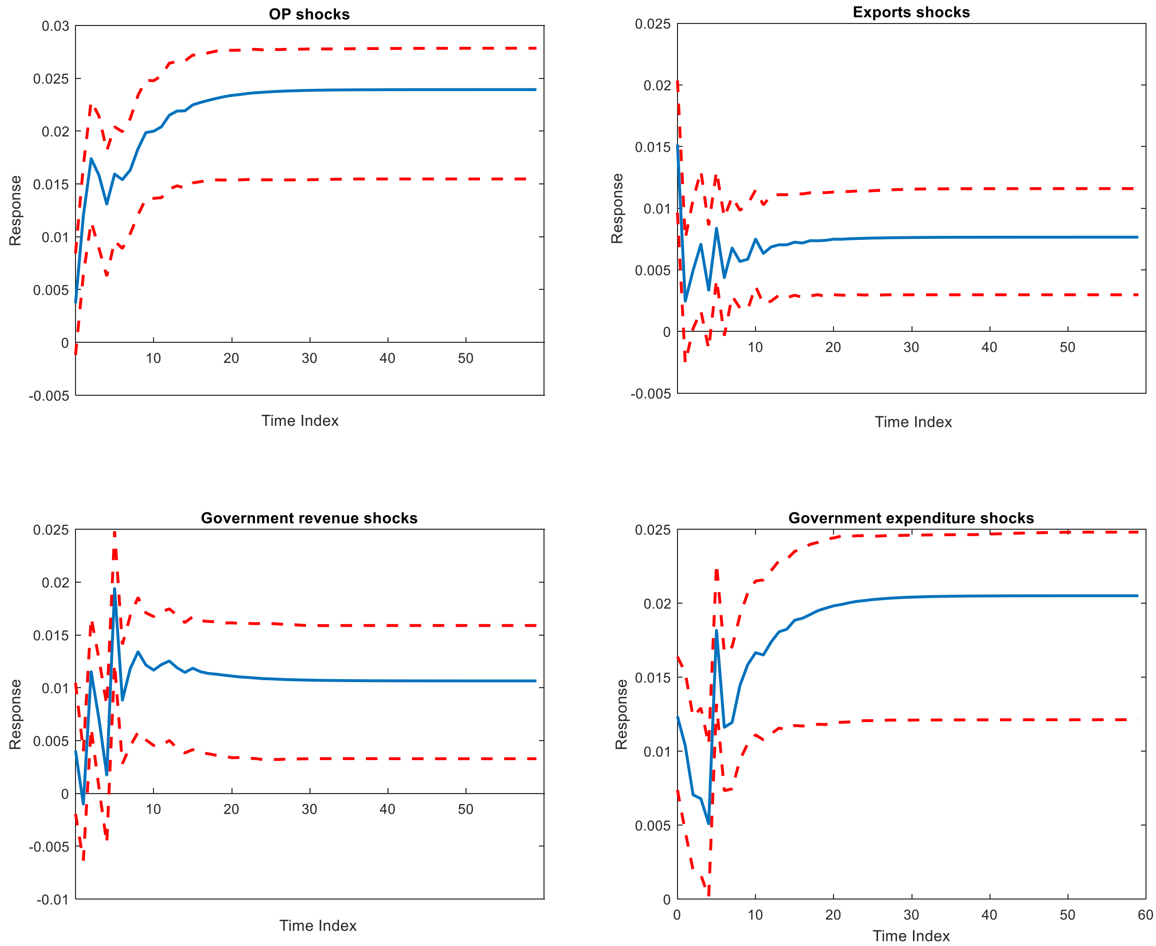


Figure 3.19 illustrates the responses of imports. Interestingly, imports responds positively and statistically significant to all four shocks, the responses fluctuate in the first 10 months then stabilised. The highest response is to the oil price shocks followed by government expenditure shocks, and the lowest is to government revenue shocks and exports shocks. The responses to government revenue shocks and exports shocks have the same pattern. These results may be explained by the fact that the government has a critical role in the economy as an employer or in the infrastructure investment. Recall as previously explained that Oman depends highly on imports for consumption and investment products.

Figure 3.19. Impulse response of imports.



3.6 Conclusion and policy implication

The Omani economy is an oil-reliant economy, where both exports and government revenue heavily depend on petroleum. The aim of this study is to examine the twin deficit hypothesis for the Omani economy, i.e. testing the relationship between fiscal balance and trade balance in the short run using SVAR model, and then testing the relationship in the long run using the SVECM model.

The results of Granger causality show that trade balance Granger-cause fiscal balance but not vice versa. In our short-run analysis, the SVAR impulse response functions show that the trade balance and fiscal balance respond to each other positively. The respond of fiscal balance to trade balance shocks is higher and statistically significant, while the respond of trade balance to fiscal balance shocks is statistically insignificant. As oil plays a crucial role in both trade and fiscal, we extend the model by adding oil price, and both trade balance and fiscal balance respond positively and statistically significant to oil price shocks, but the trade balance response was higher compared to the fiscal balance. When we replace the oil price with oil price volatility, both trade balance and fiscal balance respond negatively to oil price volatility shocks. Thus, there is a positive relationship between oil price and trade and fiscal balances, while a negative relationship was observed with oil price volatility. As trade balance responds higher than fiscal balance to oil price shocks, fiscal balance responds higher than trade balance to oil price volatility shocks. This implies fiscal balance is more endogenous, and the government able to adjust the fiscal policy to oil price fluctuations compared to trade balance which is a kind of external and more exogenous variable.

The results of forecast error variance decomposition show oil price shock's contribution is higher for trade balance compared to fiscal balance, where it is up to 58.61% for the former and up to 44.60% in the latter in the 45th quarter. The contribution of trade balance in fiscal balance is much higher compared to the contribution of fiscal balance in the trade balance, i.e. about 21.34% in the first case and 0.24% in the second case in the 45th quarter, respectively.

The historical decomposition for trade balance and fiscal balance show oil price and trade balance shocks contribute considerably to the change in trade balance. While, the three shocks, oil price, fiscal balance, and trade balance have equal contribution to the changes in fiscal balance over time.

By comparing the impulse response function among the sub-periods, trade balance responds positively to a positive fiscal balance shocks in the first sub-period (1989Q4-1996Q4) and responds negatively in the two later sub-periods (1989Q4-2006Q4) and (1989Q4-2013Q4). By contrast, fiscal balance responds positively to a positive trade balance shocks in all sub-periods. This indicates that trade balance is more exogenous variable moving with the global trend compared to fiscal balance, where for the latter, the government relatively has more control over it.

As for the long-run relationship, the results of the Johansen cointegration test demonstrates two cointegration relationship among oil price, exports, imports, government revenue, and government expenditure. The long run cointegration equation normalized in government expenditure shows a positive significant relationship with government revenue and a significant negative relationship with exports and an insignificant negative relationship with the oil price. This may indicate the government's ability to insulate the impact of oil price shocks. The second cointegration equation normalized on imports shows a positive significant relationship with exports and government expenditure and a significant negative relationship with oil price.

The SVECM impulse response results show all variables except government expenditure respond to oil price shocks. Government expenditure responds significantly to government revenue shocks but not vice versa and imports responds to exports shocks but not vice versa. Thus, there is a unidirectional impact from government revenue and exports toward government expenditure and imports.

For the interaction between fiscal and trade, government revenue responds to both exports and imports shocks, due to oil exports revenue and customs duties revenue. Compared to that, government expenditure responds to imports shocks only. On the other hand, imports responds significantly to both government revenue and government expenditure shocks, whereas exports is not responding to either government revenue nor government expenditure. These results corroborate the findings from the short-run examination for bidirectional responses between fiscal balance and trade balance.

The high contribution of petroleum in exports and government revenue, the leakage of saving in the form of workers' remittance, and growing external debt due to growing fiscal deficit cause fragile stability for Oman's internal and external balance. Government spending consolidation and exports diversification are important to maintain the internal and external balances for the Omani economy and to reduce the imbalances. Same policies may not work for all kinds of economies; thus, it is important to consider the right policy according to the economic structure.

To balance the effect of oil price fluctuations, foreign workers' remittance and the external debt, the government may increase their overseas investments. Moreover, the government should put a plan for better use of the free zones (namely the Al-Mazunah, Salalah, Sohar, Knowledge Oasis and Al-Duqm Special Economic Zones) by attracting foreign investment and establishing state-owned projects by Oman Investment Authority.

Due to the focus of this study and data limitation, the trade balance is used instead of the current account balance, though it is recommended to investigate the worker remittances and public debt for future research. The Central Bank of Oman's annual report points to that debt to GDP ratio and debt service ratio are inched up dramatically between 2014 and 2018 couples with a high fiscal deficit. In addition, high leakage from domestic saving in the form of worker remittances due to the high percentage of employees in the private sector is non-Omani. Therefore, this study could be extended in future, depending on the data availability, to include the debt and saving leakages to analyse the fiscal and external imbalances.

3.7 Appendix

Appendix 3.A: Current account

Mn. O.R	2010	2011	2012	2013	2014	2015	2016	2017	2018
Current account	**1,881**	**3,403**	**3,006**	**2,000**	**1,618**	**-4,212**	**-4,743**	**-4,138**	**-1,671**
1. Goods	**7,200**	**9,841**	**10,193**	**9,376**	**9,873**	**3,506**	**2,406**	**3,369**	**6954**
Export	14,073	18,107	20,047	21,697	20,596	13,720	10,591	12,644	16,045
Import	-6,873	-8,266	-9,854	-12,321	-10,723	-10,214	-8,185	-9,275	-9,092
2. Services	**-1,753**	**-2,081**	**-2,346**	**-2,631**	**-2,646**	**-2,622**	**-2,471**	**-2,615**	**-2,767**
Services (Credit)	694	895	1,033	1,136	1,204	1,305	1,345	1,542	1,713
Services (Debit)	-2,447	-2,976	-3,379	-3,767	-3,850	-3,927	-3,816	-4,157	-4,480
3. Income	**-1,373**	**-1,583**	**-1,732**	**-1,244**	**-1,648**	**-870**	**-713**	**-1,118**	**-2,030**
Income (Credit)	297	282	276	737	455	252	372	384	449
Income (Debit)	-1,670	-1,865	-2,008	-1,981	-2,103	-1,122	-1,085	-1,502	-2,478
4. Current Transfer	**-2,193**	**-2,774**	**-3,109**	**-3,501**	**-3,961**	**-4,226**	**-3,965**	**-3,774**	**-3,829**
Current Transfer (Credit)	0	0	0	0	0	0	0	0	0
Current Transfer (Debit)	-2,193	-2,774	-3,109	-3,501	-3,961	-4,226	-3,965	-3,774	-3,829
Worker Remittances	-2,193	-2,774	-3,109	-3,501	-3,961	-4,226	-3,965	-3,774	-3,829

Source: CBO annual report issues: 2015-2019.

Appendix 3.B: Summary of empirical studies on the relationship between fiscal balance and current account balance/ trade balance

	The study	**The country**	**Variables**	**Methodology**
1	Abell (1990)	US	Money supply, government budget deficit, Moody's AAA rated bonds, merchandise trade balance, personal income, and CPI.	- VAR
2	Akanbi (2015)	Nigeria	Current account balance, government budget balance, government expenditures, GDP (for overall economy and non-oil economy), Naira's real exchange rate, and money supply	- VAR - VECM
3	Alkswani (2000)	Kingdom of Saudi Arabia	Trade deficit and budget deficit.	- Johansen cointegration - Granger causality direction
4	Hatemi-j and Shukur (2002)	US	Budget deficit and current account deficit/ trade deficit.	- Granger Causality
5	Bagnai (2006)	22 OECD countries.	Current account to GDP ratio, government balance to GDP ratio, and private investment to GDP ratio.	- Structural breaks on long and short run relationship
6	Baharumshah et al. (2006)	Indonesia, Malaysia, Thailand and Philippines.	Budget deficit to GDP ratio, current account to GDP ratio, nominal exchange rate, and short interest rate.	- Cointegration - Granger causality test - VAR

7	Bartolini and Lahiri (2006)	26 developed countries and 16 OECD countries.	Private consumption, GDP, fiscal deficit, government consumption, public debt, GDP growth, population growth, and current account balance.	-	Panel regression with fixed effects
8	Hashemzadeh and Wilson (2006)	Middle Eastern countries	Budget deficit and current account deficit.	-	VAR
9	Kim and Kim (2006)	Korea	Budget deficit to GDP ratio, current account deficit to GDP ratio, and exchange rate.	-	Modified Wald test
10	Salvatore (2006)	G-7 countries	Current account balance as percentage of GNP, government budget balance as percentage of GNP, and growth of real GNP.	-	Linear regression analysis
11	Chen (2007)	US	Budget deficit, trade deficit, real interest, nominal exchange rate, and real exchange rate.	-	Three equation dynamic linear system
12	Kim and Roubini (2008)	US	Log of real GDP, government deficit as a percentage of GDP, current account as a percentage of GDP, three months real interest rate, and log of real exchange rate.	-	VAR
13	Marinheiro (2008)	Egypt	External debt, GDP, public consumption, current account deficit/GDP, trade deficit/GDP, budget deficit/GDP, and investment/GDP.	- -	Cointegration VECM
14	Daly and Siddiki (2009)	23 OECD	Real interest rate, current account and fiscal deficit as percentage of GDP.	-	Cointegration
15	Hashemzadeh and Wade (2010)	12 Middle Eastern countries	Trade balance and fiscal balance.	-	VAR
16	Holmes (2010)	US	Budget deficit as percentage of GDP, and current account deficit as percentage of GDP.	-	Nonlinear Augmented Dickey-Fuller
17	Kalou and Paleologou (2012)	Greece	Budget deficit, short term interest rate, nominal effective exchange rate, and current account balance.	- - -	Granger causality Cointegration VECM
18	Merza et al. (2012)	Kuwait	Budget balance and current account balance.	- -	VAR Granger causality
19	Algieri (2013)	Greece, Italy, Ireland, Portugal, Spain.	Budget balance, current account and trade account.	-	Granger causality and Toda and Yamamoto test.

20	Chihi and Normandin (2013)	24 developing countries.	External variables: world interest rate, real exchange rate, terms of trade, internal variables: domestic resources, and fiscal policy.	- Covariance - General methods of moment (GMM)
21	Trachanas and Katrakilidis (2013)	Portugal, Ireland, Italy, Greece, Spain.	Government budget deficit as percentage of GDP and current account deficits as percentage of GDP.	- Cointegration allowing for structural breaks and asymmetries.
22	Bouakez et al. (2014)	US, UK, Canada, Australia.	Tax, government spending shocks on the current account, and real exchange rate.	- SVAR
23	Elhendawy (2014)	Egypt	Budget deficit, current account balance, exchange rate, government consumption, inflation, and total debt service.	- Cointegration - Granger causality - VECM
24	Xie and Chen (2014)	11 OECD	Current account to GDP ratio, government balance to GDP ratio, and private investment to GDP ratio.	- Panel Granger causality test with bootstrap critical values
25	Ahmad et al. (2015)	9 African countries	Budget deficit to GDP, and current account deficit to GDP	- Threshold cointegration approach of Hansen and Seo.
26	Neaime (2015)	Lebanon	Government expenditure, tax revenues, budget deficit, total public debt, current account, external debt, exports, imports, and ratio of external debt to GDP.	- Cointegration - Granger causality test
27	Akanbi and Sbia (2017)	31 oil exporters	Current account balance, government budget surplus, government expenditure, exchange rate, money supply, GDP, non-oil GDP, and economic openness.	- Two-stage least squares estimation technique.
28	Helmy (2018)	Egypt	Ratio of current account to GDP, ratio of government deficit (revenue – expenditure) to GDP, ratio of trade merchandise deficit to GDP, annual interest rate, and log of nominal exchange rate.	- VAR - Granger causality - Cointegration - VECM

Appendix 3.C: Data description and source

The Variables*	Abbreviation	Frequency	Measure
Oil Price	OP	monthly (1989M07-2017M12)	Constant, seasonally adjusted, log
Exports	TOTAL_EXPORTS	monthly (1989M07-2017M12)	Constant, seasonally adjusted, log
Imports	IMPORTS	monthly (1989M07-2017M12)	Constant, seasonally adjusted, log
Government revenue	GOV_REVENUE	monthly (1989M07-2017M12)	Constant, seasonally adjusted, log
Government Expenditure	GOV_EXPENDITURE	monthly (1989M07-2017M12)	Constant, seasonally adjusted, log
Fiscal balance	FB	Quarterly (1989Q4-2017Q4)	Government revenue - government expenditure as a percentage of the real GDP
Trade balance	TB	Quarterly (1989Q4-2017Q4)	Exports - imports as a percentage of the real GDP

* Variables are in local currency (O.R)

Appendix 3.D: VAR lag order selection criteria.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	475.6509	NA	5.76E-07	-8.69084	-8.64146	-8.67082
1	553.7837	151.9648	1.48E-07	-10.0511	-9.902930*	-9.991
2	560.1445	12.13789	1.42E-07	-10.0944	-9.84748	-9.994262*
3	565.6624	10.32709*	1.38e-07*	-10.12225*	-9.77657	-9.98206
4	566.6945	1.893781	1.46E-07	-10.0678	-9.62335	-9.88755

Appendix 3.E: Unit root results for TB, FB and OP

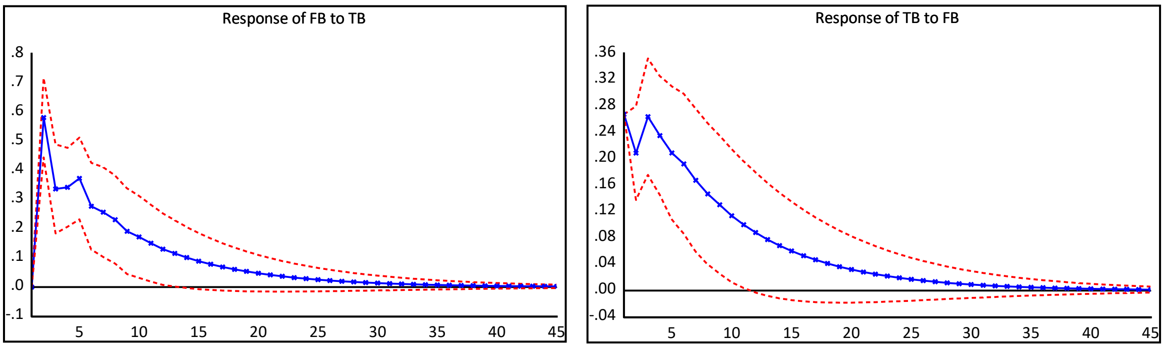
		level			1st difference		
Variables		ADF	PP	KPSS	ADF	PP	KPSS
TB	1% level	I(1)	I(0)	I(0)	I(0)	I(0)	I(0)
	5% level	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
	10% level	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
FB	1% level	I(1)	I(0)	I(0)	I(0)	I(0)	I(0)
	5% level	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
	10% level	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
OP	1% level	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)
	5% level	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)
	10% level	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)

Unit root results for OP, exports, imports, government revenue and government expenditure

		level			1st difference		
Variables		ADF	PP	KPSS	ADF	PP	KPSS
OP	1% level	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)
	5% level	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)
	10% level	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)
Exports	1% level	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)
	5% level	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)
	10% level	I(1)	I(1)	I(1)	I(0)	I(0)	I(0)
Imports	1% level	I(1)	I(0)	I(0)	I(0)	I(0)	I(0)
	5% level	I(1)	I(0)	I(1)	I(0)	I(0)	I(0)
	10% level	I(1)	I(0)	I(1)	I(0)	I(0)	I(0)
Government revenue	1% level	I(1)	I(0)	I(0)	I(0)	I(0)	I(0)
	5% level	I(1)	I(0)	I(1)	I(0)	I(0)	I(0)
	10% level	I(0)	I(0)	I(1)	I(0)	I(0)	I(1)
Government expenditure	1% level	I(1)	I(0)	I(1)	I(0)	I(0)	I(0)
	5% level	I(0)	I(0)	I(1)	I(0)	I(0)	I(0)
	10% level	I(0)	I(0)	I(1)	I(0)	I(0)	I(0)

Appendix 3.F: IRF and FEVD for model with different order $y_t = [FB, TB]'$

IRF

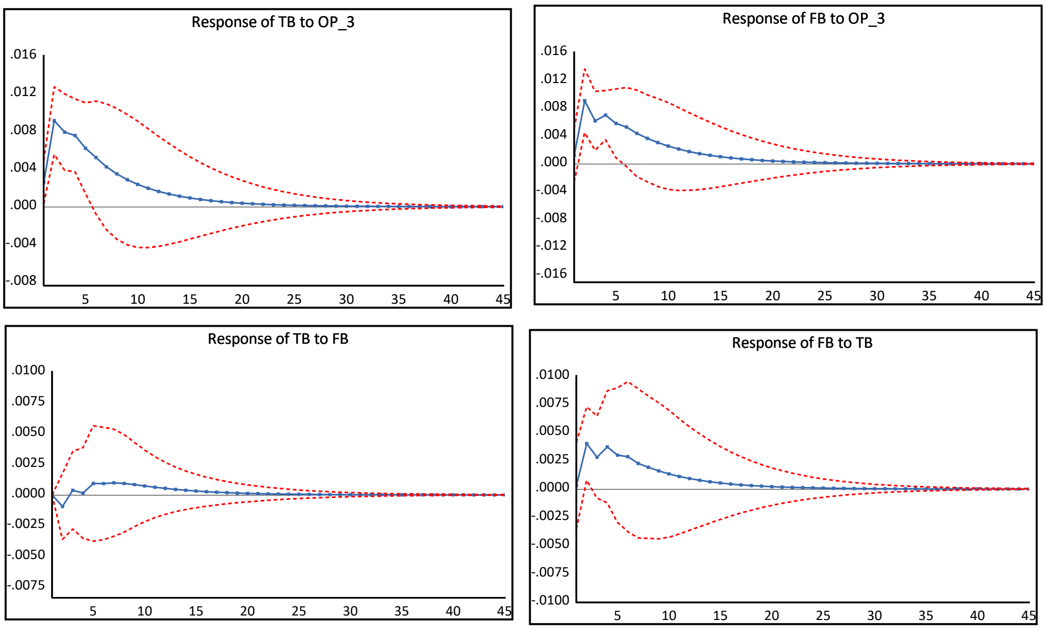


FEVD

	Variance Decomposition of FB		Variance Decomposition of TB	
Horizon (Q)	FB	TB	FB	TB
1	100.00	0.00	12.42	87.58
4	83.05	16.95	14.36	85.64
20	77.55	22.45	20.17	79.83
45	77.50	22.50	20.29	79.71

Appendix 3.G: IRF and FEVD for the model using MIDAS-VAR tool from EViews 11.

<u>IRF</u>[41]



<u>VAR Granger Causality</u>

The high frequency variable OP is significant in the third month only while is insignificant in first and second months

Dependent variable: TB				Dependent variable: FB			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
OP_1	1.48	2	0.48	OP_1	3.26	2	0.19
OP_2	2.15	2	0.34	OP_2	1.31	2	0.52
OP_3	23.77	2	0	OP_3	13.43	2	0.001
FB	0.83	2	0.66	TB	10.73	2	0.005
All	29.74	8	0.0002	All	38.62	8	0

<u>FEVD</u>[42]

Horizon (Q	Variance Decomposition of TB:		Variance Decomposition of FB:	
	TB	FB	TB	FB
1	59.55	0.000	0.02	85.81
4	33.40	0.130	4.23	53.07
20	28.16	0.644	6.001	41.21
45	28.15	0.646	6.005	41.18

[41] IRF are 95% since the scaled IRF cause error in EViews 11.
[42] In the MIDAS-VAR, the contribution of the high frequency variables (OP) is not shown in FEVD.

Appendix 3.H: FEVD for model with OP_V, TB and FB.

Horizon (Q)	Variance Decomposition of TB			Variance Decomposition of FB		
	OP_V	TB	FB	OP_V	TB	FB
1	0.21	99.78	0.00	0.74	11.95	87.31
4	0.85	99.13	0.03	7.56	36.34	56.10
20	1.03	98.93	0.04	6.64	46.29	47.07
45	1.03	98.93	0.04	6.63	46.33	47.03

Appendix 3.I: Pairwise Granger causality test*

Null Hypothesis:	**F-Statistic**	**Prob.**
OP does not Granger Cause EXPORT	7.15	0.00
OP does not Granger Cause GOV_REVENUE	3.85	0.00
OP does not Granger Cause GOV_EXPENDITURE	1.53	0.11
OP does not Granger Cause IMPORTS	1.63	0.08
GOV_REVENUE does not Granger Cause OP	0.57	0.87
GOV_REVENUE does not Granger Cause EXPORT	0.49	0.92
GOV_REVENUE does not Granger Cause GOV_EXPENDITURE	2.07	0.02
GOV_REVENUE does not Granger Cause IMPORTS	1.81	0.05
GOV_EXPENDITURE does not Granger Cause OP	0.88	0.57
GOV_EXPENDITURE does not Granger Cause EXPORT	0.68	0.77
GOV_EXPENDITURE does not Granger Cause GOV_REVENUE	0.56	0.87
GOV_EXPENDITURE does not Granger Cause IMPORTS	1.25	0.25
EXPORT does not Granger Cause OP	1.48	0.13
EXPORT does not Granger Cause GOV_REVENUE	3.27	0.00
EXPORT does not Granger Cause GOV_EXPENDITURE	1.17	0.30
EXPORT does not Granger Cause IMPORTS	2.16	0.01
IMPORTS does not Granger Cause OP	0.95	0.49
IMPORTS does not Granger Cause EXPORT	1.87	0.04
IMPORTS does not Granger Cause GOV_REVENUE	1.69	0.07
IMPORTS does not Granger Cause GOV_EXPENDITURE	1.70	0.07

*12 lags used as a rule of thumb for monthly data.

CHAPTER 4

4 THE TRANSMISSION OF THE GLOBAL SHOCKS TO THE OMANI ECONOMY THROGH TRADE LINKAGES

4.1 Introduction

The rising global interdependencies result in rising global shock spill over across countries because now the global economies are closely connected through trade and financial linkages. These linkages act as channels for shock transmission across economies. The growing interdependencies across markets, countries and national economies need to be understood and assessed for macroeconomic policy analysis and risk management (Dees, Mauro, et al., 2007).

Trade shock from emerging economies exert significant influence on demand and prices of global commodities. The trade linkages are the main transmission channels through which foreign shocks impact the resource-rich countries such as Sub-Saharan and Middle Eastern economies (Yang & Samaké, 2011; Gauvin & Rebillard, 2018). Oil prices, compared to metal prices, appear to be more sensitive to shock originating from China and the United States (US). China's shock is also found to have more persistent effects on commodity prices (see for example Chatterjee & Saraf, 2017).

The world business cycle movements are associated with rising trade and financial linkages (Kose et al., 2008). The growing spill overs among economies may be through direct channel, i.e. bilateral trades, foreign direct investments, exchange rate movements, and technological changes. The spill over could also be through indirect channels such as global demand, international commodity prices, and world interest rates (Yang & Samaké, 2011). In fact, since the 1960s, the growth rate in world trade is higher than the world output growth. The trade linkages create demand and supply spill overs across economies (Kose et al., 2003), making it an important shock transmission channel across countries (Baxter & Kouparitsas, 2005; Chatterjee & Saraf, 2017; Gauvin & Rebillard, 2018). More specifically, for oil commodity, there is a strong relationship between oil price shock and global economic activities (Kilian, 2009; Dong et al., 2019; Raghavan, 2020).

The assessment of bilateral spill overs and policy implications should be based on a close examination of the relationship among countries, as the bilateral relations often vary from country to country (Yang & Samaké, 2011). This study aims to investigate the impact of trade shocks originating from Oman's main trading partners, namely China, Japan, South Korea,[43] Singapore, Thailand, and the US. Oman is a small open petroleum-reliant economy, and Asia is the main exports destination for the

[43] The Republic of Korea

Omani oil. The Asia Pacific region is considered as one of the most dynamic regions in the global trade and a major driver of global economic growth (Dungey et al., 2018). For a long time, Japan accounts for the largest portion of Omani oil exports. Since 2000s China is Oman's main export destination. This study examines the effects of the changing trade flows between Oman and its trading partners, and their implications on the Omani economy amid changing oil prices.

Recently Oman along with its Middle Eastern neighbours and North African countries are dealing with several uncertainties and external risks which have economic sequences. For examples, the external risks are trade tensions between the US and China, geopolitical risks and oil price volatility and its impact on the fiscal and external balances of these oil-exporting countries. The volatile global financial conditions result in higher interest burdens, revaluation of foreign debt and financial sector stress in these countries (IMF, 2019). As oil prices remain extremely volatile, the crude oil volatility index rose to its highest value on record in March 2020 (OPEC, 2020). This intensified the concern over the effects of the increase in oil price volatility (Baumeister & Peersman, 2013), and causing economic uncertainties and delays in budget stability leading to low economic growth (Majumder et al., 2020).

Sultanate of Oman is a commodity exporter and for more than five decades, petroleum contributes up to 78.5%, 84.2% and 58.4% of the Omani total exports in 1995, 2005 and 2015, respectively (NCSI, 2018). In 2019 petroleum contributes up to 68.4% of the total exports, where 94.0% of the petroleum exported to East Asia (NCSI, 2020). Among the Middle Eastern oil exporters, Oman has the highest export intensity, measured as a percentage of GDP to China, where about 19.0% of its exports are concentrated with China, while only 1.0% with the US and 1.0% with Euro Area (IMF, 2018). In 2016, 2017 and 2018, Oman exports about 78.0%, 76.9% and 83.1% of its oil to China (NCSI, 2019). The boom in the Chinese economy led to an unprecedented demand for natural resources (Yang & Samaké, 2011; Cesa-Bianchi et al., 2012; Kilian & Hicks, 2013; Dungey, Fry-McKibbin, et al., 2014; Chatterjee & Saraf, 2017; Gauvin & Rebillard, 2018; Raghavan, 2020). In 2011, China consumed around 11.0% of the global oil consumption and while in the last ten years, 42.0% of the increase in global oil consumption has been driven by China (Gauvin & Rebillard, 2018).

The slowdown in the Chinese economy can have direct and indirect effects on commodity exporters' economies. The commodity price emerges as an important channel for China's shock transmission, and China's effect is higher on emerging countries as compared to advanced economies (Chatterjee & Saraf, 2017). Any Chinese hard-landing would cause commodity prices to fall (Gauvin & Rebillard, 2018). The impact from China due to a direct link via bilateral trade and indirect link through the impact on the commodity prices would affect China's main trading partners (Cashin et al., 2017). These expected impacts are confirmed by COVID-19 crisis which originated in China, spread worldwide leading to an oil price plunge, stock market and global economic uncertainties.

We use Global Vector Autoregressive (GVAR) methodology developed by Dees, Mauro, et al. (2007) to investigate the impact of the global shocks on the Omani economy through trade linkages. As in a standard VAR model, the solution of GVAR is also used for shock scenario analysis and forecasting. The main benefit of using the GVAR is that it contains number of cross-section countries and each cross-section countries contain number of variables. Thus GVAR utilizes a panel structure (Chudik & Pesaran, 2016). Conditional on alternative configurations of cross-country linkages in the world economy, the spill over happens across economies via financial, trade and commodity linkages can be captured at the world level using the GVAR framework (Dees, Mauro, et al., 2007; Alawadhi et al., 2018). For Oman, the exports plus imports as a percentage of GDP is generally high. Moreover, for the oil commodity, which is Oman's export commodity has a strong relationship with global economic activities. We investigate the impact of trade shocks originating from Oman's main trading partners to Oman as a small open petroleum-dependent economy. These trading partners received 89.5% of Omani oil exports value in 2019 (NCSI, 2020). We used quarterly data over the period 1989Q4 to 2016Q4.

Our results show the Omani economy is relatively susceptible to shocks from China, highlighting its high trade exposure and vulnerability to the state of China's economy. The response of Oman's GDP to a shock to China's GDP is considerable and persistent, compared to other trading partners, including the US and Japan. By re-estimating the model using different trade weights, Oman's responses to the US shocks are almost similar across different periods. The influence of China is still the highest among all partners using different trade weights. In contrast, the influence of Japan's shocks declined over time. By breaking down the total GDP into petroleum and non-petroleum GDP, the results show that the international shocks have a higher and more persistent impact on the petroleum GDP compared to the non-petroleum GDP.

The remaining of the study is organized as follows. Section 4.2 gives a brief about the Omani economy. Section 4.3 details the methodology and the data used, section 4.4 reports the empirical results and discussion. Finally, section 4.5 concludes and propose some policy recommendations.

4.2 An overview of the Omani economy

Oman is a small oil producer and exporter with daily oil production less than one million barrels. Although Oman is a small oil producer, petroleum plays a crucial role in the Omani economy, as the main source of government revenue, exports commodity and economic activity.

Petroleum is a vital economic activity in Oman as it contributes relatively high to GDP. Despite oil price swing, the contribution of petroleum activities to Omani GDP appears to be almost similar across times. For example, in 2016, 2017, and 2018 petroleum accounts for about 41.8%, 40.4% and

40.8% of the total GDP, respectively (NCSI, 2019).[44] This could be due to an increase in quantity exported as oil price declined. For instance, when oil price declined by 29.03% between 2015 and 2016, the exports quantity of oil increased by 5.4% (CBO, 2016a).

In Oman, both fiscal and trade outlooks are linked to the oil price. The contribution of petroleum in government revenue and exports moves in line with the trend of global oil price. In 2016, when the oil price was 40.1 US$/BBL, the petroleum contributes around 57.9% of total exports and 68.2% of total government revenue. In 2017, oil price improved by 28%, i.e. oil price increased to 51.3 US$/BBL; therefore, the contribution to exports increased to 58.2% and around 72.9% to government revenue. In 2018, when the oil price was 69.7 US$/BBL, the percentage raised to 65.3% of exports and 78.2% of government revenue. Thus, the fiscal deficit as a percentage of the expenditure, decreased to 41.1%, 30.6%, and 19.4% in 2016, 2017 and 2018, respectively (NCSI, 2019). Moreover, Oman's external account significantly improved with oil price recovery (CBO, 2019).

The sum of exports and imports as a percentage of GDP is an indicator of an economy's openness to international trade (Huntington, 2015). Majumder et al. (2020) found that trade openness is a possible channel to reduce the resource curse in oil-rich countries as they gain competitive price for their resources in the international market. As Table 4.1 shows, the exports plus imports as a percentage of GDP in Oman is generally more than 90%, classifying it as a super trading nation. It was 104.2% in 2014 when the oil price was 103.2 US$/BBL but declined to 94.8% and 77.8% in 2015 and 2016 when the oil price declined to 56.5 US$/BBL and 40.1 US$/BBL, respectively. Driven by oil price recovery to 51.3 US$/BBL and 69.7 US$/BBL in 2017 and 2018 and with the improvement in non-oil exports, the percentage rebounded to 84.5% and 85.8%, respectively (CBO, 2019). The table also illustrates the trade balance, which is the difference between merchandise exports and imports, and it is also moving with the oil price trend. The trade balance as a percentage of GDP declined by 68.8% between 2014-2015 and by 35.6% between 2015-2016, reaching 5.6% in 2016 compared to 27.9% in 2014. Then the trade balance recovered and bounced back by 50.0% between 2016-2017 to 8.4% of the GDP in 2017. Compared to 50.0% improvement between 2016 and 2017, the trade balance achieves a big jump in 2018 by 132.1% compared to 2017.

Table 4.1. Exports and imports, and trade balance (2010-2018)

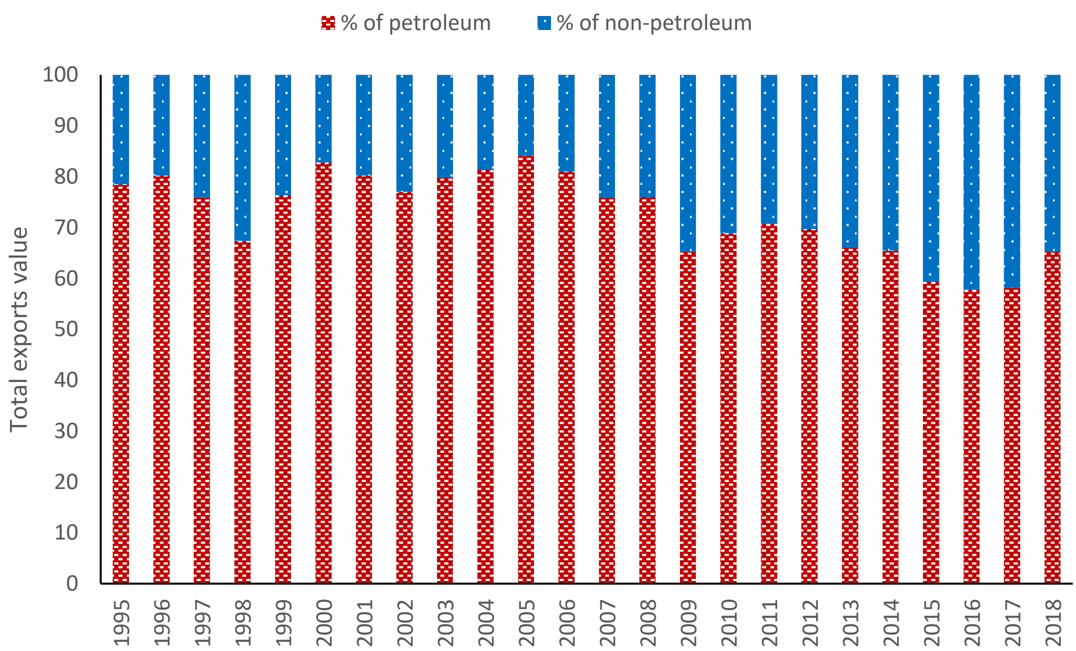
Trade balance	2010	2011	2012	2013	2014	2015	2016	2017	2018
Export and import as % of GDP	96.5	104.7	105.8	116.8	104.2	94.9	77.8	84.5	85.8
Trade balance as % of GDP	28.4	34	30.8	26.5	27.9	8.7	5.6	8.4	19.5

Source: CBO annual report issues: 2015,2019.

[44] At constant price of 2010.

Petroleum is the main export commodity for Oman since the late 1960s. The importance of oil export can be seen in Figure 4.1 below, with a high contribution of petroleum in the total exports value between 1995 and 2018. Though the percentage varies across time, but in general it is high. Closer inspection of the figure shows the highest contribution was about 84.0% in 2005. The lowest was 56.7% in 2016 when the oil price was 40.1 US$/BBL, then following the oil price recovery to 69.7 US$/BBL in 2018 the percentage increased to 65.3% (NCSI, 2019). This substantial contribution of petroleum put the Omani economy in a vulnerable state to any external shocks through trade linkages from the global economic slowdown and or a slowdown in the trade partners' economies.

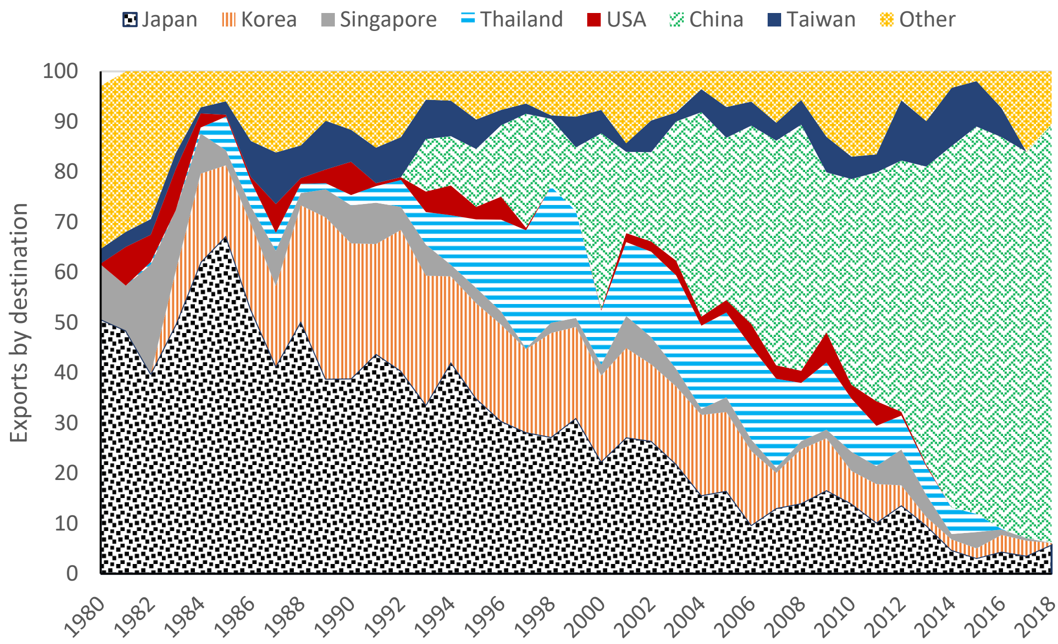
Figure 4.1. The percentage of petroleum and non-petroleum from the total exports (1995-2018)



Source: Different issues of the Statistical Yearbook, NCSI.

Figure 4.2 illustrates the destinations for Omani oil exports from 1980 to 2018. It is obvious from Figure 4.2 that the Asian market is the main destination for Omani oil. As stated in the literature, Asia is one of the most dynamic regions in global trade and a major driver of global economic growth. In addition, the rapid growth of China over the past decades has been one of the main drivers for the rise in demand and prices of mineral commodity and energy. Currently, China is the main exports destination for Omani oil. China started to import the Omani oil in 1993, and since then it has dominated as main exports destination, where up to 78.0%, 76.9% and 83.1% of total oil exports of Oman is exported to China in 2016, 2017 and 2018, respectively (NCSI, 2019). Before China, from the 1980s to 2000, Japan was the main exports destination for Omani oil. Since 1983, Oman also exports a reasonably large amount of oil to Korea, Singapore and Thailand. Compared to these destinations, Oman's exports to the US is relatively small.[45]

Figure 4.2. The exports destination for the Omani oil (1980-2018)



Source: Different issues of the Statistical Yearbook, NCSI.

Figure 4.3 illustrates the overall trade flow, which is the average of total exports and imports, between Oman and its trade partners. These selected trade partners are the main exports destinations for the Omani oil.[46] However, about 47.43% of Oman's non-oil exports, goes to Gulf Cooperation Countries (GCCs) and in return, Oman receives about 56.52% of imports from these countries (NCSI, 2019). Consistent with the discussion above, the trade flow is gradually increasing with China, while it is decreasing with Japan. By contrast, trade flows with Korea and Thailand are stable over time. The trade flow with the US and Singapore are relatively small compared to other countries.

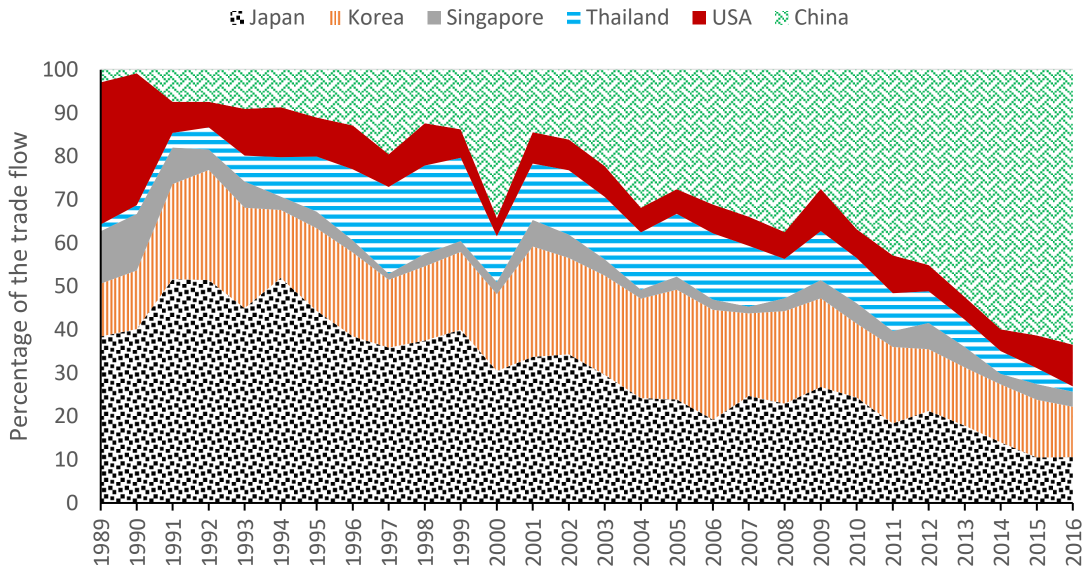
There are three types of oil price shocks: oil supply shocks, aggregate demand shocks and oil-specific demand shocks (Kilian, 2009). The determinants of oil price movements are global economic growth, supply disruption and geopolitical uncertainties, technological changes and or unprecedented health crisis like the COVID-19. Ramp in oil production in Saudi Arabia, the reimposition of the US sanction on Iran, supply disruption in Libya, Iran and Venezuela, increases in the US shale oil

[45] Recently India appearing as a considerable destination for the Omani oil. In 2017, 2018 and 2019 about 9.6%, 7.6% and 4.8% of the Omani oil exported to India. Before that, there is no individual time series data regarding the exported quantity of oil to India may be it included under other countries group (NCSI, 2020).

[46] Taiwan is excluded from the analysis although it is one of the importers since 1980th till now. This is due to unavailability of exports and imports data for Taiwan with other countries in the IMF Direction of Trade Statistics.

production, and weak demand from big trade partners like China, Russia and Europe are examples of concern about oil price movements (IMF, 2019).

Figure 4.3. The trade flow, an average of exports and imports, between Oman and it's trade partners



Source: Direction of Trade and Statistics, IMF.

The policymakers in Oman are aware of their exposure to these vulnerabilities due to the heavy dependence on petroleum export. Therefore, Oman vision 2020 and the current 2040 vision emphasise on economic diversification to insulate the economy from external shocks. It is deemed important to empower the non-petroleum sector for sustainable development and to generate continuous employment opportunities. The Omani government have started the National Program for Enhancing Economic Diversification, knowns as 'Tanfeeth' to improve five non-petroleum sectors namely, the manufacturing, tourism, mining, logistics and fishing (CBO, 2019). These sectors were largely ignored in the past due to the flourishing oil price, which is considered as a symptom of the Dutch Disease.[47]

The spill over from the global economy to Oman may happen directly through bilateral trade, foreign direct investment, exchange rate movement and technological change, as well as indirectly through global demand, international commodity price and world interest rate. The world trade is growing to make the trade linkages as an important shock transmission channel across countries associated with business cycle movement. The impact may be due to direct bilateral trade and indirect through the impact on commodity prices and third market. As mentioned before the exports plus imports as a percentage of GDP is generally high for Oman. Moreover, for the oil commodity, which is the main

[47] The Dutch Disease is a process of a boom in a natural resource sector that results in shrinking the non-resource tradable, leading to specialisation in the resource and non-tradable sectors leaving the economy more vulnerable to resource-specific shocks (Ismail, 2010).

export commodity for Oman, there is a strong relationship between oil price shocks and global economic activities. We will investigate the impact of trade shocks originating from Oman's main trading partners to Oman as a small open petroleum-reliant economy. The study will examine the effects of changing trade flows and influence from the trade partners using different trade weights to construct the foreign variables and link to the Omani economy. Thus, this assessment of bilateral spill overs and policy implications are based on a close inspection of the relationship among Oman and its bilateral trade relations as the trade relationship often vary from country to country. This interlink between Oman, its trade partners and oil price are presented in Figure 4.4, and we are using the GVAR model, that will be explained in the next section, to achieve this goal. GVAR can assess the patterns of co-movement of core macroeconomics variables for the economies; such as output, inflation, and interest rate, and the channels for the global shocks; such as oil prices shocks or specific national shocks and use it for shocks scenarios analysis and forecasting.

4.3 Methodology and Data

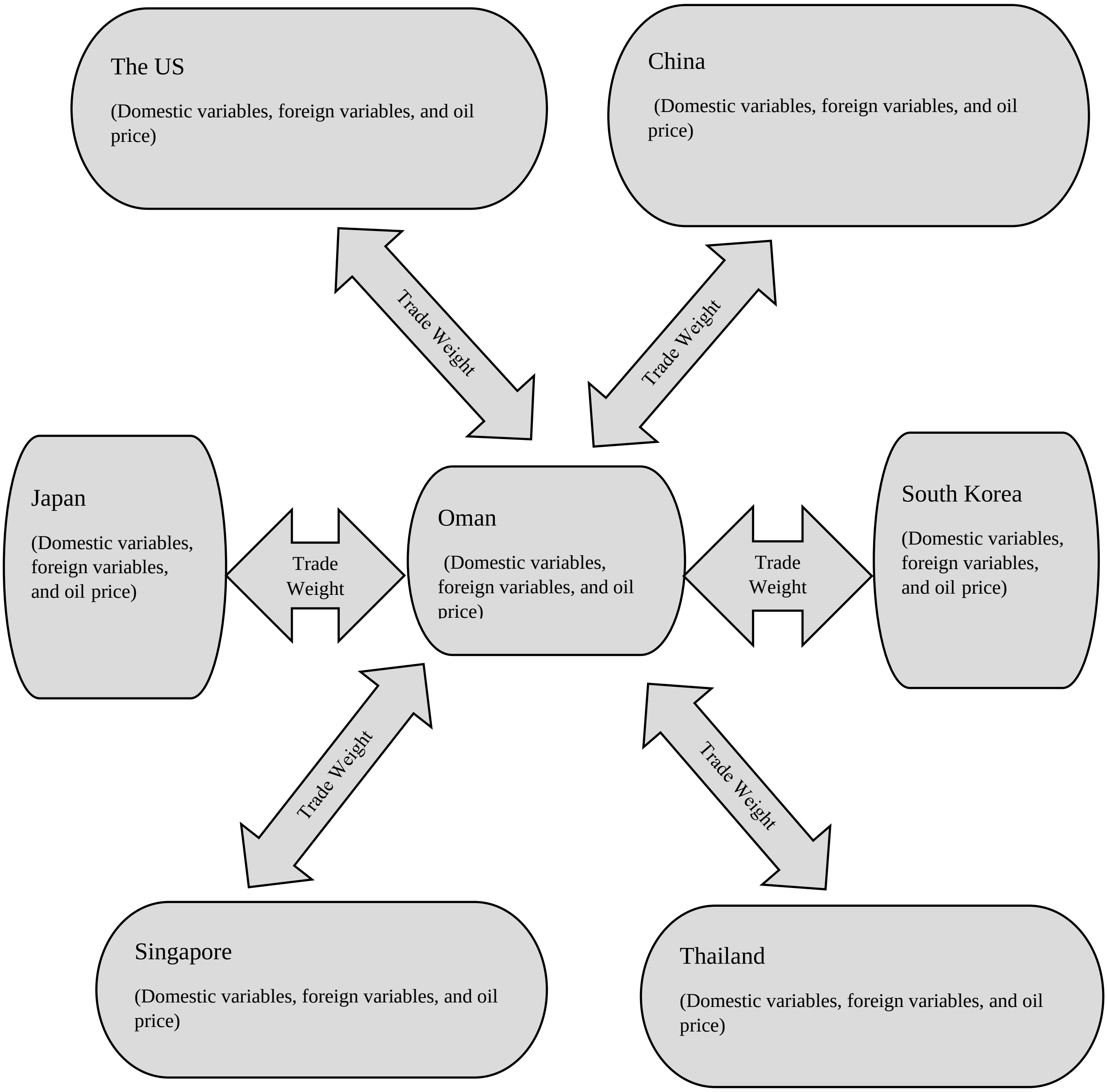
This section provides details about the GVAR model and data used to examine the impact of the global shocks on the Omani economy through trade linkages.

4.3.1 A general overview of the methodology

Global Vector Autoregressive (GVAR) model developed by Dees, Mauro, et al. (2007) is an extension based on Pesaran et al. (2004) work. Due to globalisation, there are many shock transmissions channels across economies; via trade and commodity and financial linkages. These linkages can be captured at the world level using a GVAR model. The GVAR is a multi-country model which links country-specific models using time series and panel data techniques (Dees, Mauro, et al., 2007; Mohaddes & Pesaran, 2017).

Conditional on alternative configurations of cross-country linkages in the world economy, the spill over happens across economies via linkages of finance, trade, and commodity. In GVAR it is advisable to use trade weights compared to the financial weights as it captures the political and cultural interlinkages across countries and it also revealed to be the most important determinant of national business cycle co-movements (Baxter & Kouparitsas, 2005; Cesa-Bianchi et al., 2012; Chudik & Pesaran, 2016; Mohaddes & Pesaran, 2016; Cashin et al., 2017; Alawadhi et al., 2018). GVAR can assess the patterns of co-movement of core macroeconomics variables for the economies such as output, inflation, interest rate and equity prices for the business cycle and several channels for the global shocks such as changes in oil price shocks or specific national or sectoral shocks (Dees, Mauro, et al., 2007).

Figure 4.4. Structure of the relationship between Oman and its trading partners



The model is estimated in two steps. In the first step, each country modelled as a small open economy by estimating country-specific vector autoregressive models (VARX*) in which domestic variables are related to both country-specific foreign variables and global variables. In the second step, a global model is constructed by combining all the estimated country-specific models and linking them via a matrix of predetermined cross-countries linkages. The one large GVAR model solved for various shock scenarios analysis and forecasting (Chudik & Pesaran, 2016).

Most of the GVAR literature has focused on business cycle linkages among developed and major emerging market economies, and there is limited attention to growth spill over to the oil exporters or the Middle Eastern and North African countries (Yang & Samaké, 2011; Mohaddes et al., 2012; Cashin et al., 2014). Also, recently a growing literature draws attention to the growing influence of China on the commodity prices (see for example Cashin et al., 2017; Chatterjee & Saraf, 2017; Gauvin & Rebillard, 2018).

4.3.2 Modelling the GVAR and data

As mentioned before, GVAR modelled through two steps. In the first step, there are small-scale country-specific models conditional on the rest of the world, in which domestic variables are related to both country-specific foreign variables and global variables. These models are presented as augmented vector autoregressive models (VARX*), including domestic variables and foreign variables known as 'star variables' which treated as weakly exogenous. In the second step, the individual country VARX* models stacked and solve simultaneously as one GVAR model. Thus, the base of the GVAR approach is a small-scale country-specific models which can be estimated separately.

Consider $(N+1)$ countries in the global economy indexed by $i=0,1,\dots,N$. Except for the US which is modelled as a reference economy $i=0$; all countries are modelled as small open economies. This set of individual VARX* models is used to build the GVAR model. Following Pesaran (2004) and Dees, Mauro, et al. (2007), VARX* (p_i,q_i) model for i th country $(k_i\times 1)$ vector of domestic macroeconomic variables treated as endogenous variables (x_{it}) related to $(k_i^*\times 1)$ vector of country-specific foreign variables (x_{it}^*) treated as weak exogenous, and to $(m_d\times 1)$ vector of observed global factors (d_t) variables with constant and deterministic time trend as in equation (4.1):

$$\boldsymbol{\Phi}_i(L,p_i)\boldsymbol{x}_{it}=\alpha_{i0}+\alpha_{i1}t+\boldsymbol{\Lambda}_i(L,q_i)\boldsymbol{x}_{it}^*+\boldsymbol{\Upsilon}_i(L,q_i)\boldsymbol{d}_i++\boldsymbol{u}_{it} \qquad (4.1)$$

For $t=1,2,\dots,T$, where α_{i0} and $\alpha_{i1}$are $(k_i\times 1)$ vector of fixed intercepts and coefficients on the deterministic time trends respectively. and $\mathbf{u}_{it}$ is $(k_i\times 1)$ vector of country-specific shocks, which we assume are serially uncorrelated with zero mean and a non-singular covariance matrix $\sum_{ii}$ namely

$u_{it} \sim i.i.d.(0, \sum_{ii})$. Furthermore, $\mathbf{\Phi}_i(L, p_i) = \mathrm{I} - \sum_{i=1}^{p_i} \mathbf{\Phi}_i L^i$, $\mathbf{\Lambda}_i(L, q_i) = \sum_{i=0}^{d_i} \mathbf{\Lambda}_i L^i$ and $\mathbf{\Upsilon}_i(L, q_i) = \sum_{i=0}^{q_i} \mathbf{\Upsilon}_i L^i$ are the matrix lag polynomial of the coefficients associated with domestic, foreign and global variables, respectively.

The VARX* models are including a maximum of six domestic variables (endogenous variables), depending on whether data are available for a variable, and exogenous variables. The domestic variables are real GDP, (y_{it}), the rate of inflation,(π_{it}), short term interest rate, (r_{it}^{s}), long-term interest rate, (r_{it}^{l}), exchange rate, (ep_{it}), and real equity prices, (eq_{it}). There is a pattern of co-movement between these variables and the business cycle which increases the economic and financial cointegration leading to essential macro-economic policy spill overs across countries (Dees, Mauro, et al., 2007). In addition, these variables are the commonly used variables in the GVAR literature (Cashin et al., 2014).

Following the literature, and due to the dominance of the US in the world economy; it is modelled differently. The global variable oil price in this case, (d_t), treated as endogenous in the US model, while a weakly exogenous for other countries in the model. Between 1979 and 2010 US consumed, on average, about 27% of world oil. Compared to the other three major oil importers, China, Euro Area, and Japan; the US consumption is far larger than other countries. Also, including oil price in the US model acts as a transmission mechanism for the global economic conditions to the oil price (Cashin et al., 2014). Moreover due to the importance of US financial variables in the global economy, the US-specific foreign variables $(r_{US,t}^{*s}), (r_{US,t}^{*l})$, and $(eq_{US,t}^{*})$ are not included in the country-specific model. In addition, the domestic currency price of the US dollar is by construction determined outside this model.

The data for the domestic variables (x_{it}) for each country, as well as the oil price, is obtained from the GVAR package.[48] Then the dataset is augmented with the Omani economy's variables. For more details see Smith and Galesi (2014) and Mohaddes and Raissi (2018).[49] Refer to Appendix 4.A for data description.

As the lag orders of these variables (p_i) and (d_i) are selected on a country-by-country basis, we are explicitly allowing for $\mathbf{\Phi}_i(L, p_i)$, $\mathbf{\Lambda}_i(L, q_i)$ and $\mathbf{\Upsilon}_i(L, q_i)$ to differ across countries.

The country-specific foreign variables (x_{it}^{*}) are constructed as cross-sectional averages of the domestic variables using data on bilateral trade as the weights, w_{ij}:

[48] The oil price is from the GVAR database and not the Omani oil price. The oil price in this case is a Brent crude oil price which is the quarterly series, the average of the daily closing price for all trading days within the quarter (Mohaddes & Raissi, 2018). The correlation between the world oil price and country-specific oil supply shocks tend to be zero as there are large number of oil producers, except for Saudi Arabia (Mohaddes & Pesaran, 2016).
[49] GVAR toolbox can be downloaded from: https://sites.google.com/site/gvarmodelling/gvar-toolbox.

$$\boldsymbol{x}_{it}^{*} = \sum_{j=0}^{N} w_{ij}\boldsymbol{x}_{jt} \qquad (4.2)$$

Where $w_{ij}, i, j = 0, 1, \ldots, N,$ $\mathrm{w}_{ii} = 0$ and $\sum_{j=0}^{N} \mathrm{w}_{ij} = 1$. In the GVAR literature, different trade weights have been used (see for example Mohaddes et al., 2012; Cashin et al., 2014; Mohaddes & Pesaran, 2016; Cashin et al., 2017; Alawadhi et al., 2018; Gauvin & Rebillard, 2018).

For empirical application and following Dees, Mauro, et al. (2007); in this study we have applied the trade weights that are computed as fixed weights based on the average trade flows measured over the period 1999 to 2001.[50] The estimation of foreign variables and solution of GVAR is based on fixed trade weights, using a three-year average to reduce the impact of individual yearly movement on the weights:

$$w_{ij} = \frac{T_{ij,1999} + T_{ij,2000} + T_{ij,2001}}{T_{i,1999} + T_{i,2000} + T_{i,2001}}$$

where T_{ijt} is the bilateral trade of country i with country j during a given years t and is calculated as the average of exports and imports of country i with j and $T_{it} = \sum_{j=0}^{N} T_{ijt}$ (the total trade of country i) for t = 1999,2000, and 2001.

The bilateral trade weight is calculated as the average of exports and imports of a specific country with its trade partner over a specific time (Cashin et al., 2014). In our study, petroleum is the main source of exports and government revenue for the Oman economy; therefore, the selected trading partners include the partners which received 89.5% of Omani oil exports value in 2019 (NCSI, 2020). These countries are China, Japan, Korea, Singapore, Thailand and the US, and they account for around 93.0%, 84.0%, and 89.0% of Oman's total oil exports in 2016, 2017 and 2018 respectively (NCSI, 2019). We consider the exports and imports because Oman depends largely on imports for food, consumption, and investment products (CBO, 2019), and government revenue from oil has an impact on government investment plans. Therefore, including exports and imports will capture more comprehensively the trade pattern for the Omani economy.

In addition to the 1999-2001 trade weight, we also use three different trade weights as shown in Table 4.2. They highlight three demand-driven oil price shocks: (i) between 1997 and 1999, the decrease in demand for crude oil caused by Asian Financial Crisis (AFC), followed by an economic

[50] The trade weights can based at any time period or can be allowed to be time-varying (Mohaddes et al., 2012; Cashin et al., 2014).

crisis in Russia, Brazil and Argentina, (ii) between 2007 and 2009, the decline in demand for industrial commodities including crude oil due to global recession and the Global Financial Crisis (GFC). And (iii) between 2014 and 2016, oil price drop caused by sluggish global economic activity, increase in US shale oil production, increase in oil production from Canada and Russia, and less impact from geopolitical conflict on the supply-side in the Middle East (Baumeister & Kilian, 2016; Koh, 2016).

Table 4.2. Trade weights period's description

Description	Three years average weight
AFC	1997-1999
GFC	2007-2009
Sluggish global economic activity	2014-2016

By focusing on these three sets of average trade weights, we can quantify how changes in trade patterns may have altered the impact and the transmission of shocks to the Omani economy. Indeed, including three different weights will give a better sense of time evolution of estimated impacts and provide evidence on the robustness of the results.

Although the estimation is done country-by-country basis, the GVAR model is solved for the world, taking in account that all variables are endogenous to the system as a whole. After estimating each country VARX*(p_i, q_i) model separately, all the $k = \sum_{i=0}^{N} k_i$ endogenous variables collected in the $k \times 1$ vector $\mathbf{x}_t = (\mathbf{x}'_{0t}, \mathbf{x}'_{1t}, \dots, \mathbf{x}'_{Nt})'$, need to be solved simultaneously using the link matrix defined in terms of the country-specific weights. Thus, we can write the VARX* model in equation (4.1) more compactly as:

$$\boldsymbol{A}_i(L, p_i, d_i)\boldsymbol{z}_{it} = \varphi_{it} \qquad (4.3)$$

For $i = 0,1, \dots, N$, where

$$\boldsymbol{A}_i(L, p_i, q_i) = [\boldsymbol{\Phi}_i(L, p_i) - \boldsymbol{\Lambda}_i(L, q_i)], \boldsymbol{z}_{it} = (x'_{it}, x'^{*}_{it})', \varphi_{it} = \boldsymbol{\alpha}_{i0} + \boldsymbol{\alpha}_{i1} t + \boldsymbol{\Upsilon}_i(L, q_i)\boldsymbol{d}_t + \boldsymbol{u}_{it} \; (4.4)$$

Note that given equation (4.2) we can write:

$$\boldsymbol{z}_{it} = \boldsymbol{W}_i \boldsymbol{x}_t \qquad (4.5)$$

Where $\mathbf{W}_i = (\mathbf{W}_{i0}, \mathbf{W}_{i1}, \dots, \mathbf{W}_{iN})$ with $\mathbf{W}_{ii} = 0$ weight matrix for country i defined by the country-specific weights, w_{ij}. using equation (4.5) we can write equation (4.3) as:

$$\boldsymbol{A}_i(L,p)\boldsymbol{W}_i\boldsymbol{x}_t = \varphi_{it} \qquad (4.6)$$

Where $\mathbf{A}_i(L,p)$ is constructed from $\mathbf{A}_i(L,p_i,q_i)$ by setting $p = max(p_0, p_1, \dots, p_N, q_0, q_1, \dots, q_N)$ and augmenting the $p - p_i$ or $p - q_i$ additional terms in the power of the lag operator by zeros. Stacking equation (4.6), we obtain the GVAR(p) in domestic variable only:

$$\boldsymbol{G}(L,p)\boldsymbol{x}_t = \varphi_t \qquad (4.7)$$

Where,

$$\boldsymbol{G}(L,p) = \begin{pmatrix} \boldsymbol{A}_0(L,p)\boldsymbol{W}_0 \\ \boldsymbol{A}_1(L,p)\boldsymbol{W}_1 \\ \cdot \\ \cdot \\ \cdot \\ \boldsymbol{A}_N(L,p)\boldsymbol{W}_N \end{pmatrix}, \varphi_t = \begin{pmatrix} \varphi_{0t} \\ \varphi_{1t} \\ \vdots \\ \cdot \\ \varphi_{Nt} \end{pmatrix} \qquad (4.8)$$

The GVAR(p) model in equation (4.7) can be solved recursively and used for several purposes, i.e. to generate impulse response functions or forecast.

4.3.3 Unit root test, lag order selection, cointegration, and persistence profiles

We need to consider the unit root properties of the variables included in our GVAR model. If the domestic variables (x_{it}), foreign variables (x_{it}^*), and the global variable (d_t) in the country-specific models are integrated of order one I(1), then we can distinguish between short and long-run relationships, and interpret the long-run relationship as cointegrating. We perform the Augmented Dickey-Fuller (ADF) test on the level and first difference for all variables. We also perform weighted symmetric (WS-ADF) test introduced by Park and Fuller (1995), because it has been shown to have better power properties than the ADF test. The results reported in Appendices 4.B, 4.C, and 4.D support the treatment of variables in our model as I(1) and they are stationary in the first difference.

The VARX* model allows the cointegration among domestic and foreign variables. However, before we examine the cointegration relationship among the variables; we need to determine the lag orders of domestic and foreign variables (p_i) and (q_i). For this purpose, we use the Akaike Information Criteria (AIC). Following the GVAR literature and given the constraints imposed by data limitations, we set the maximum lag order to $p_{max} = 2$ and $q_{max} = 1$, and the selected VARX* orders are reported in Table 4.3. The specification seems satisfactory, except for two countries Singapore and Thailand for which AIC selected $p = q = 1$.

Having established the lag order of country-specific models, we proceed to determine the number of long-run relationships. Cointegration test with the null hypothesis of no cointegration, one cointegration, and so on are carried out using Johansen's maximum eigenvalue and trace statistics developed by Pesaran et al. (2000) for models with weakly exogenous I(1). Choosing the number of cointegrating relations (r_i) based on trace test statistics because it has better small sample properties compared to maximum eigenvalue test using 95% critical values from MacKinnon et al. (1999). The number of cointegrations in the specific-country models are shown in Table 4.3 and more details in are provided Appendix 4.E.

Table 4.3. VARX* lag order and number of cointegrating relations

Country	p_i	q_i	Cointegrating relations (r_i)
OMAN	2	1	1
JAPAN	2	1	1
KOREA	2	1	1
SINGAPORE	1	1	1
THAILAND	1	1	1
CHINA	2	1	1
USA	2	1	2

$\boldsymbol{p_i}$ and $\boldsymbol{q_i}$ are lag order of domestic variables and foreign variables respectively and selected by Akaike Information Criterion (AIC). The number of cointegration relations (r_i) are selected using the trace test statistic based on the 95% critical values from MacKinnon et al. (1999) for all countries. The number of (r_i) are reduced below that suggested by trace statistic to ensure the global model stability.

If the variables are cointegrated, the shocks will be transitory and eventually disappear as the economy returns to the equilibrium, but if the variables are not cointegrated, the impact of shocks will persist forever (Pesaran & Shin, 1996). Persistence profiles (PPs) are the time profiles of the effects of the system or variable-specific shocks on the cointegrating relations in the GVAR (Dees, Holly, et al., 2007). Persistence profiles capture the difference between cointegrating and non-cointegrating relationships to provide unique time profiles for the effect of these shocks of the cointegrating relations.

The impact of PPs is normalised to unit value, and the rate at which they tend to zero provides information about the speed in which the equilibrium correction takes place in response to shocks. The PPs could initially over-shoot and exceed unity but eventually must tend to zero if the relationship under consideration is cointegrated.

If there is a slow speed of adjustment and convergence for some economies, reducing the number of cointegration for these economies will lead to a well-behaved PPs (Mohaddes & Pesaran, 2016; Cashin et al., 2017). Appendix 4.F shows the PPs tend to zero as the horizon increases for all cointegrating relationships in economies under consideration. Moreover, the speed of convergence is also high, which is a good indication that identified cointegrating vectors are appropriate.

4.3.4 Trade weights and contemporaneous effects

The trade weight matrix is the bilateral trade weight calculated as the average exports and imports of country i with country j over the total trade of country i in a specific time (Cashin et al., 2014), and it sums down to one as shown in Table 4.4. The trade weight matrix is built based on the trade flows between Oman and its trading partners (The US, China, Japan, Korea, Thailand, and Singapore), and used to estimate the foreign variables and linking country-specific models in the GVAR model. The full trade weights matrices are available in Appendix 4.G.

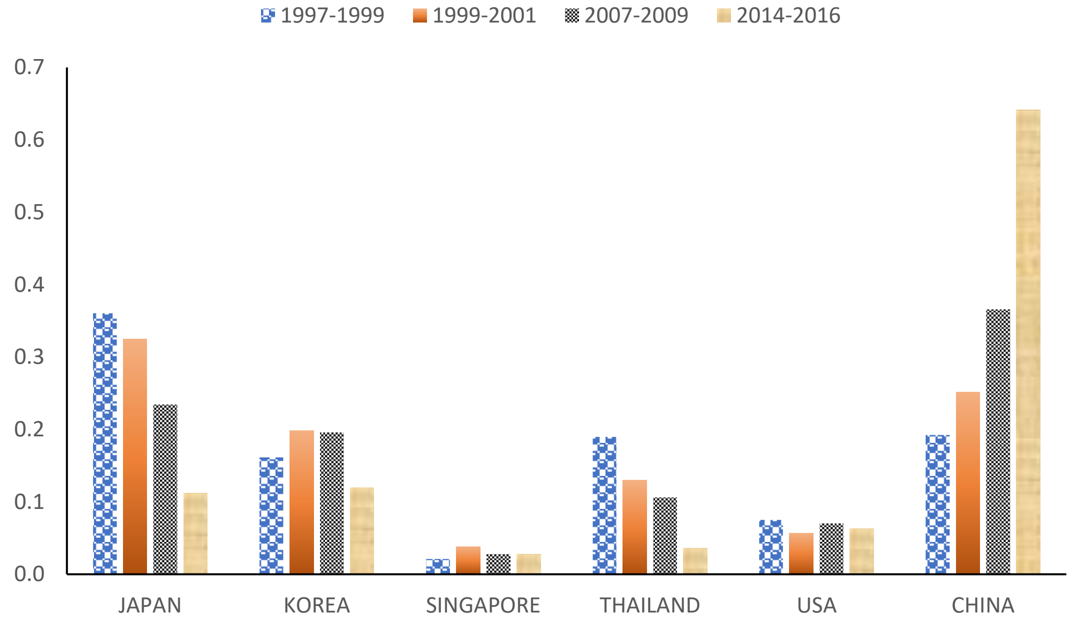
Figure 4.5 visualises the evolving of trade patterns between Oman and its trade partners over time. The most interesting aspect of this graph is the changing importance of two main trade partners of Oman: China and Japan. The trade weights show the growing influence of China and the declining influence of Japan. Using average trade weight 1997-1999, Japan was the main trading partner for Oman, which accounts for 36.0% of total exports and imports, compared to only 19.2% with China. The percentage of trade with China jumped to 36.6% and 64.1% using trade weight 2007-2009 and 2014-2016, respectively. In contrast, the trade share with Japan declined by half between these two weights, to 23.4% and 11.2%, respectively. Our findings are consistent with Mohaddes et al. (2012), who used different trade weights averaged over 1986-1988 and 2006-2008, and found the trade between China and MENA countries increased many folds in the latter period. The trade relationship with the US ranges between 5.7% and 7.5%, while Korea varies between 12.0% and 19.9%. The trade declined substantially with Thailand, from 19.0% to 3.6% using trade weights 1997-1999 and 2014-2016, respectively. The trade relations with Singapore are small and stable, around 2.8% across all four trade weights. In the next section, we will explore the influence of these countries' shocks on the Omani economy through trade linkages. We will assess how the Omani economy reacts to different weights over time.

Table 4.4. Average trade weights: 1997-1999, 1999-2001, 2007-2009 and 2014-2016

	1997-1999	1999-2001	2007-2009	2014-2016
JAPAN	0.360	0.325	0.234	0.112
KOREA	0.161	0.199	0.196	0.120
SINGAPORE	0.021	0.038	0.028	0.028
THAILAND	0.190	0.130	0.106	0.036
CHINA	0.192	0.252	0.366	0.641
USA	0.075	0.057	0.070	0.063
Total	1.000	1.000	1.000	1.000

Trade weight is computed as the share of exports and imports. Source: Direction of Trade and Statistics, IMF.

Figure 4.5. Changes in Oman's trade flow with its' trade partners over time



The contemporaneous effects given by the estimated coefficients of contemporaneous relationships of the foreign variables on their domestic counterparts. It can be interpreted as impact elasticities between domestic and foreign variables, and it provides information about the international linkages between domestic and foreign variables. High elasticity between domestic and foreign variables, imply strong co-movements between the two variables.

Table 4.5 shows the elasticity measure of Oman's GDP elasticity using different average trade weights. Though the results show there is a positive elasticity between the domestic and foreign GDP across all four trade weights, only the last two trade weights are statistically significant. This shows increasing trade integration of the Omani economy with the global economy over time.

Table 4.5. Contemporaneous effects of foreign variables on domestic counterpart

Trade weight	1999-2001	1997-1999	2007-2009	2014-2016
GDP	0.8157 (1.30)	0.6902 (1.20)	1.4276 (2.12)	0.9232 (1.60)
Petroleum GDP	3.3724 (4.30)	2.617 (3.53)	3.456 (4.37)	2.624 (3.72)
Non-petroleum GDP	-0.1106 (-0.18)	-0.046 (-0.074)	-0.058 (-0.095)	0.033 (0.063)

t-ratio are in parentheses.

To examine the importance of petroleum in the Oman economy, we break down the GDP into petroleum and non-petroleum GDP. As expected, the elasticity of petroleum GDP to changes in the corresponding foreign counterpart is way more sensitive compared to that for GDP, as Table 4.5 above shows. In contrast, the elasticity of non-petroleum GDP is small, statistically insignificant, and is negative in three out of the four trade weights.

4.4 Empirical results and discussion

This section presents the results of the generalized impulse response functions (GIRFs) and generalized forecast error variance decomposition (GFEVD).

4.4.1 The generalized impulse response functions

The impulse response functions are the time profile of the effects of variable-specific shocks or identified shocks like technology shocks or monetary policy shocks on all the variables in the model. Due to spill over effects across countries in a multi-country context, there is a need to allow for the possibility that some of the structural shocks might be correlated. To allow for non-zero correlations across the structural shocks, we use the generalized impulse response function (GIRF) introduced by Koop et al. (1996) and Pesaran and Shin (1998). GIRF is based on the moving average representation of the GVAR model, and it is invariant to the variables and countries order, which is important in the multifactor macroeconomic model (Dees, Mauro, et al., 2007). The GIRF approach is not based on prior economic theory or canonical system, but it is a counterfactual exercise based on a historical correlation of shocks as given (Chudik & Pesaran, 2016).

The GIRFs graphs illustrate the responses of Oman's GDP to a number of adverse shocks with bootstrap random draws and 16th and 84th percentile error bands. The GDP is used as a core indicator for a country's economic assessment over time, and for assessment relative to other economies (Van den Bergh, 2009). The results section includes the GIRFs of Oman's GDP, petroleum GDP (GDP_P), and non-petroleum GDP (GDP_NP) using the four different average trade weights.

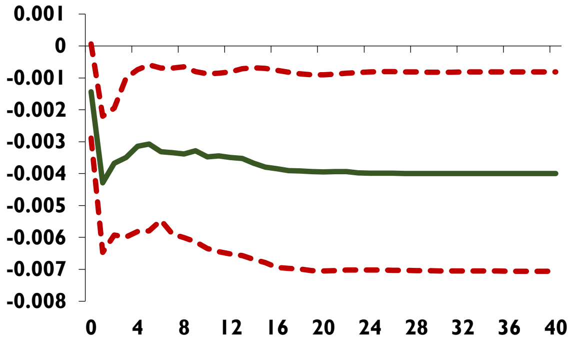
4.4.1.1 GIRFs of Oman's GDP to shocks to the trade partners' GDP

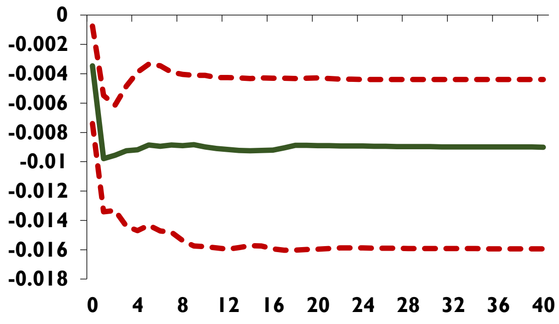
Figure 4.6 illustrates the responses of Oman's GDP to one standard deviation negative GDP shock to Oman's trade partners using average trade weight 1999-2001. The response of Oman's GDP to a shock from China's GDP is considerable and persistent, compared to the other five countries, including the US and Japan. The initial impact of China is around 1%, compared to only 0.4% from the US. Given the size of China and its role in the global value chain, any economic slowdown in China will spill over to the global economy, particularly through trade linkages (Cashin et al., 2017). In contrast, the impact of Japan is sizeable in the first four quarters, up to 0.6%, then it declines to 0.3%. This outcome is consistent with that reported by Dungey et al. (2018), that China's influence overtook the EU and Japan as the main source of shocks, via trade linkages, to output growth of the Asian countries. Moreover, Oman's exports of oil to China grew from 77% in 2017 to 83.1% in 2018 (NCSI, 2019). Thus, commodity price emerges as an important channel for the transmission of Chinese shocks, and the Chinese effect is felt higher in emerging countries as compared to advance countries (Chatterjee & Saraf, 2017). The GVAR forecast, reported in Appendix 4.H, shows China is leading the global economic growth with a steady increase in GDP, reflecting the continuous growth since 2000 (Cashin et al., 2017; Dungey & Osborn, 2019). While growth levels in the US and Japan have flattened, growth in Singapore, Korea, and Thailand have a similar level. Consequently, our finding supports the vulnerability of the Omani economy to the Chinese shocks.[51] Oman's GDP also responds significantly to negative shocks from Korea and Thailand. The response of Oman's GDP to shocks from Singapore is short-lived.

[51] China surpassing the US in 2016 as the world's largest oil importer, consumes 14 million barrels a day, recently because of COVID-19, the Chinese oil demand dropped by 20% of the total consumption (https://www.bloomberg.com/news/articles/2020-02-02/china-oil-demand-is-said-to-have-plunged-20-on-virus-lockdown).

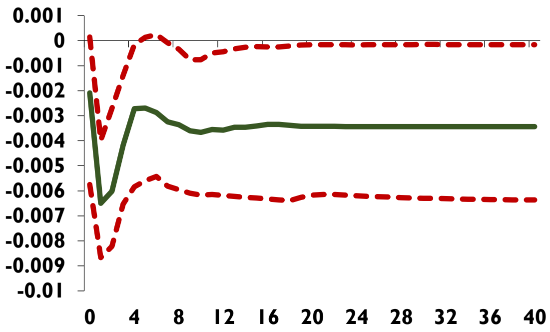
Figure 4.6. The median impulse responses of the Omani GDP to one standard deviation fall in the trade partners' GDP, using average trade weight 1999-2001

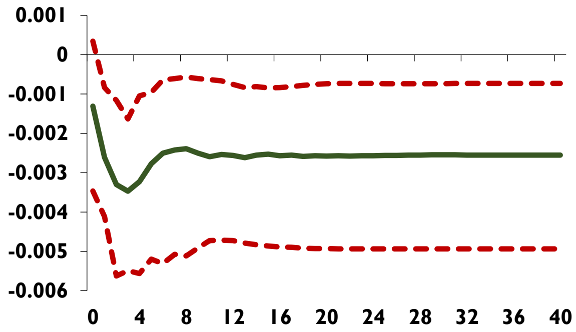
US	China



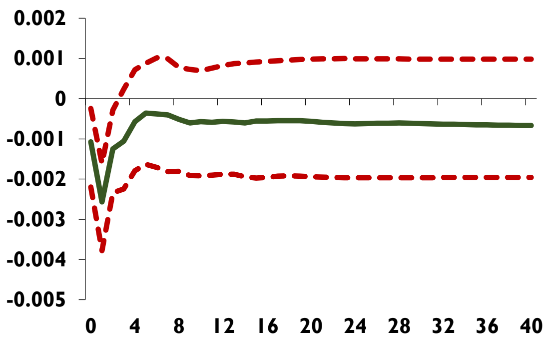


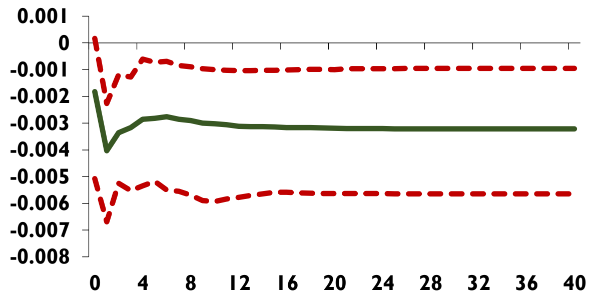
Japan	Korea





Singapore	Thailand





Note: All figures are with 68% bootstrap confidence bound. The horizon is quarterly.

4.4.1.2 GIRFs of Oman’s GDP to shocks to the trade partners’ GDP over time

To investigate the evolving effects of Oman’s trade relations over time, we use the three different average trade weights described in Section, 3 i.e. for the periods 1997-1999, 2007-2009, and 2014-2016 to estimate the GVAR. Figures 4.7 and 4.8 show the responses of Oman’s GDP to negative output shocks to Oman’s trade partners, and the results appear to be in line with those using trade weights for the period 1999-2001. Since the relative trade weights with the US is stable across times, Oman’s responses to the US shocks are also similar for different trade weights. This outcome is consistent with Mohaddes et al. (2012), who also found the impact of US GDP shocks on the Middle East and North Africa countries (MENA) countries has not changed much since the mid-1980s. Contrary to the expectations, the responses to China’s shocks have remained significant across time, even though the trade share with China evolved dramatically from 19.2% in 1997-1999 to 64.1% in 2014-2016. The Chinese GDP shock affects Oman more strongly using trade weights 1997-1999; this negative response could be associated with the Asian Financial Crisis (AFC). The effect is considerable and persistent using trade weights 2014-2016, compared to 2007-2009 weights. By contrast, using two different trade weights averaged over 1986-1988 and 2006-2008, Mohaddes et al. (2012) found the impact of Chinese GDP shocks on the Middle East and North Africa countries has significantly increased particularly for less-diversified commodity exporters. The influence of Japan’s shocks declined compared to decades ago, corroborate with the decline in trade weight from 36.0% in 1997-1999 to 11.2% in 2014-2016. In fact, the response to Japan’s shocks turns to be statistically insignificant using the last two trade weights 2007-2008 and 2014-2016 after the 4th quarter. Likewise, the response to Thailand’s shocks declined as the trade weights declined over time. The effect of Thailand’s shock was highest using trade weights 1997-1999, as the AFC started from Thailand. By contrast, the response of Korea is relatively stable and similar across the different trade weights, while the response to Singapore is small and short-lived except for the trade weight 2014-2016.

Figure 4.7. The median impulse responses of the Omani GDP to one standard deviation fall in the trade partners’ GDP, using three average trade weights (1997-1999, 2007-2009, and 2014-2016)

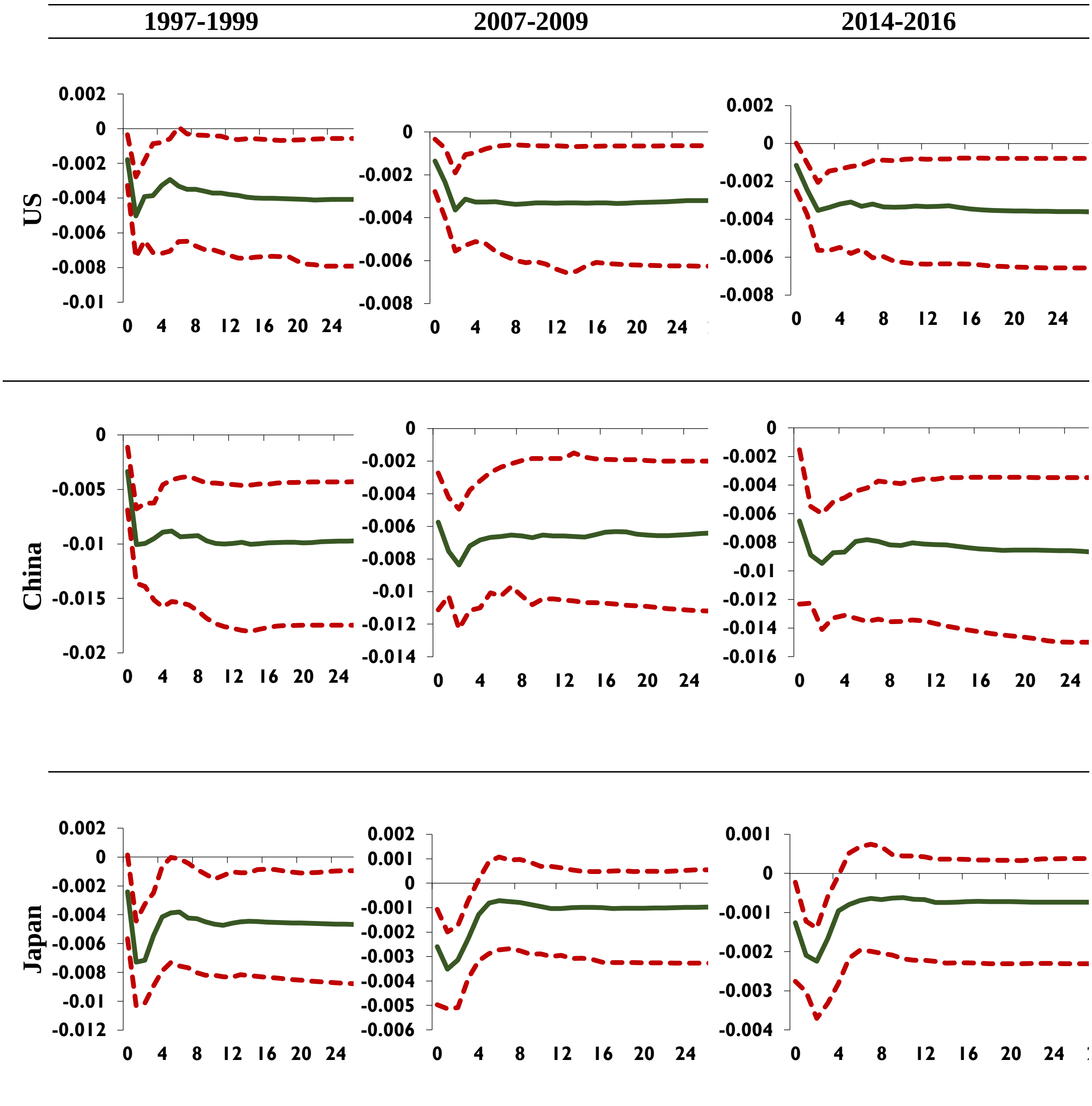
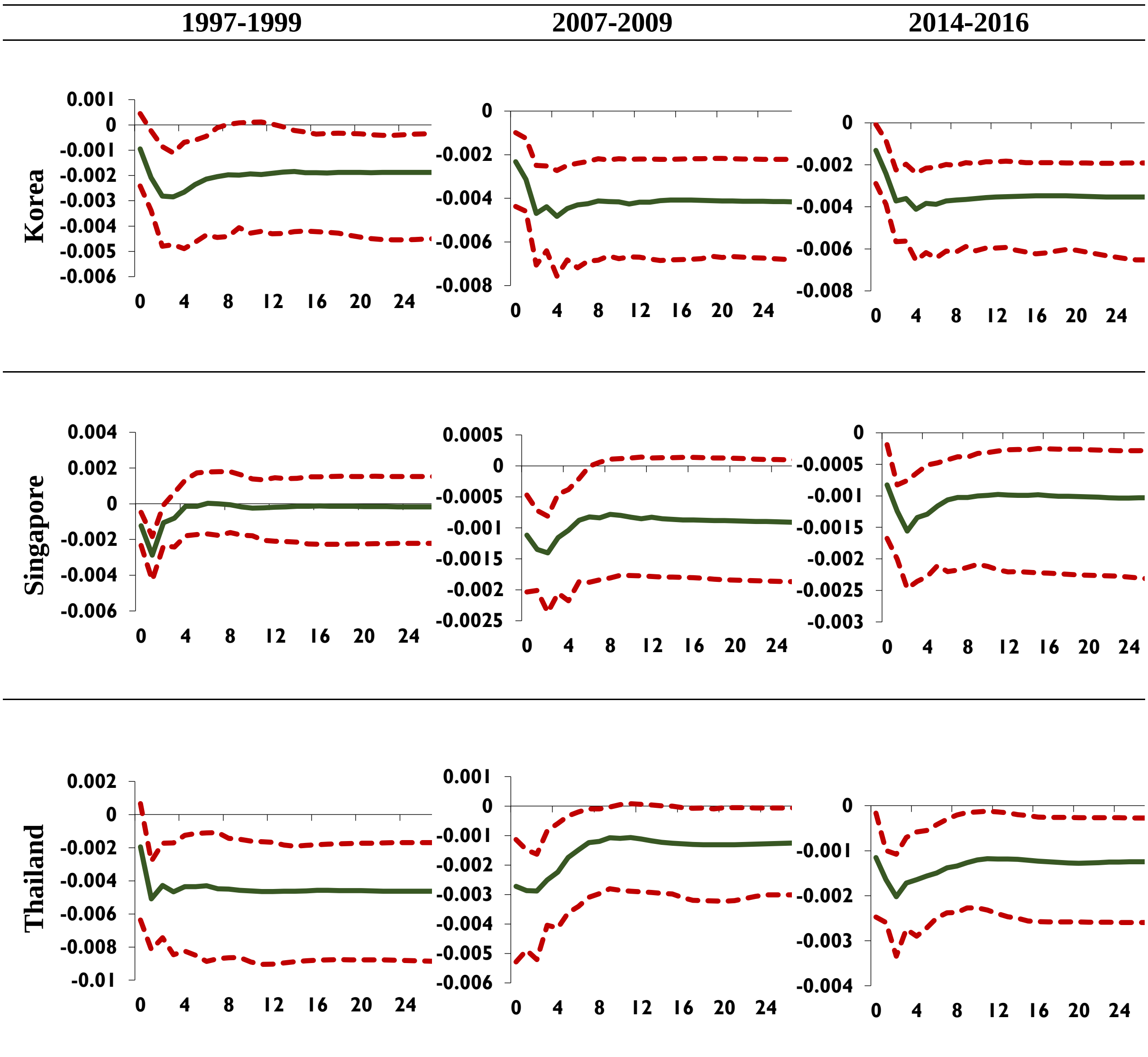


Figure 4.8. The median impulse responses of the Omani GDP to one standard deviation fall in the trade partners' GDP, using three average trade weights (1997-1999, 2007-2009, and 2014-2016)



4.4.1.3 GIRFs of GDP sub-components: petroleum and non-petroleum

Due to the importance of petroleum to the Omani economy as the main export commodity and economic activity, this section investigates the difference in responses between petroleum GDP (GDP_P) and non-petroleum GDP (GDP_NP). The percentage of petroleum GDP to the total GDP was 41.8%, 40.4% and 40.8% in 2016, 2017, and 2018, respectively (NCSI, 2019). The non-petroleum GDP includes agriculture and fisheries, industry sector, and services activities. Appendix 4.H illustrates smooth upward parallel growth of oil price, total Omani GDP, and GDP subcomponents: petroleum and non-petroleum. The total GDP is expected to grow with the oil price, and the prediction of non-petroleum GDP is expected to grow higher than petroleum GDP, which is a good indicator in line with Oman's aim to diversify the economy.

Figures 4.9 and 4.10 display the responses of petroleum and non-petroleum GDP to one standard deviation negative GDP shock to Oman's trade partners using 1999-2001 average trade weights. The results show that international shocks have more impact on the petroleum GDP compared to the non-petroleum GDP. The petroleum GDP reactions are larger, persistent, and statistically significant to shocks from all trade partners except for Singapore. In contrast, the responses of non-petroleum GDP are smaller and statistically significant to only China, Korea, and Thailand. Consistent with the response of total GDP; petroleum and non-petroleum GDP respond higher to China's shock compared to other economies. Both petroleum and non-petroleum respond highly in the first four quarters and then taper off.

Figure 4.9. The median impulse responses of the Omani GDP subcomponents to one standard deviation fall in the trade partners' GDP, using trade weight 1999-2001

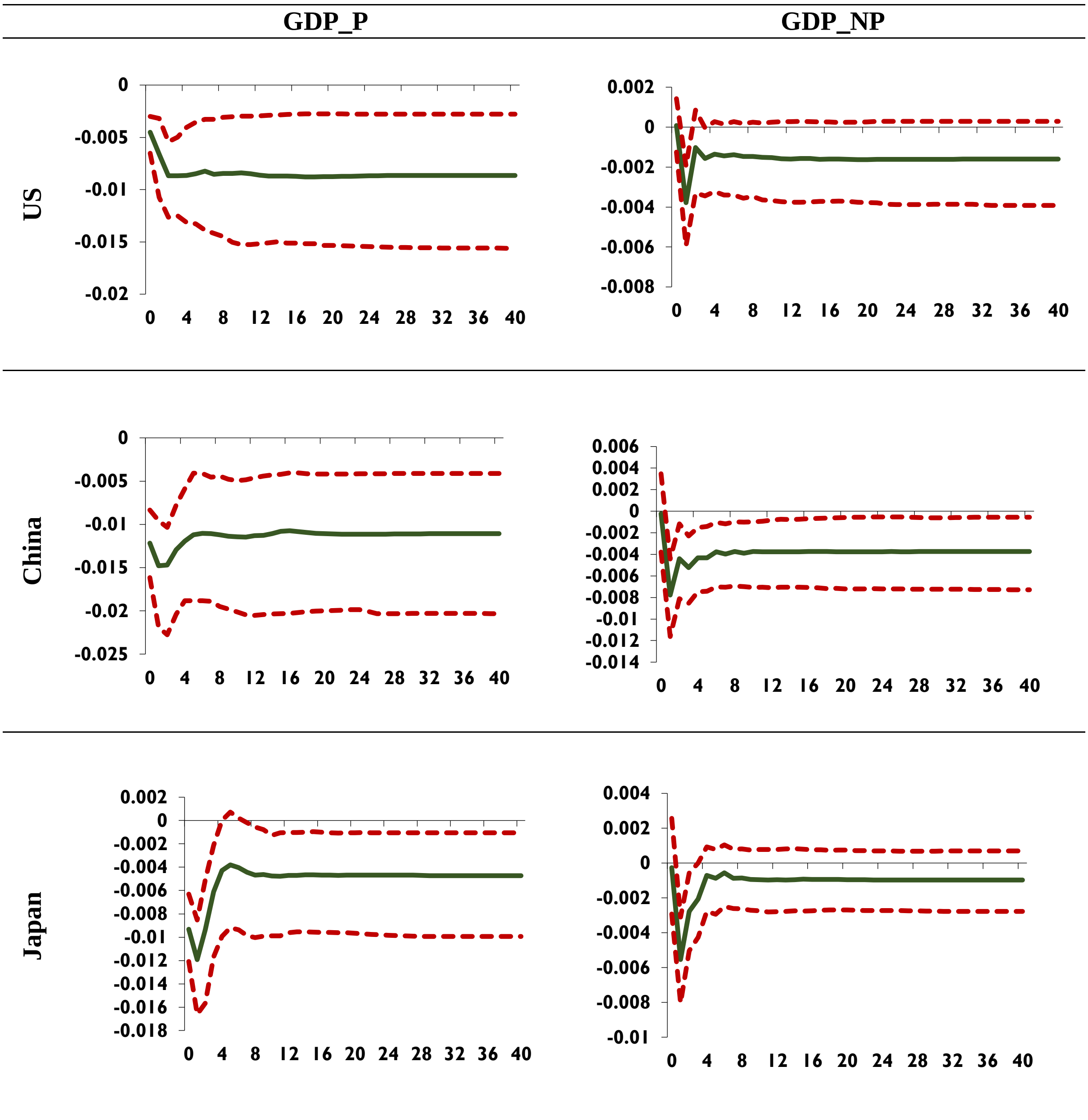


Figure 4.10. The median impulse responses of the Omani GDP subcomponents to one standard deviation fall in the trade partners' GDP, using trade weight 1999-2001

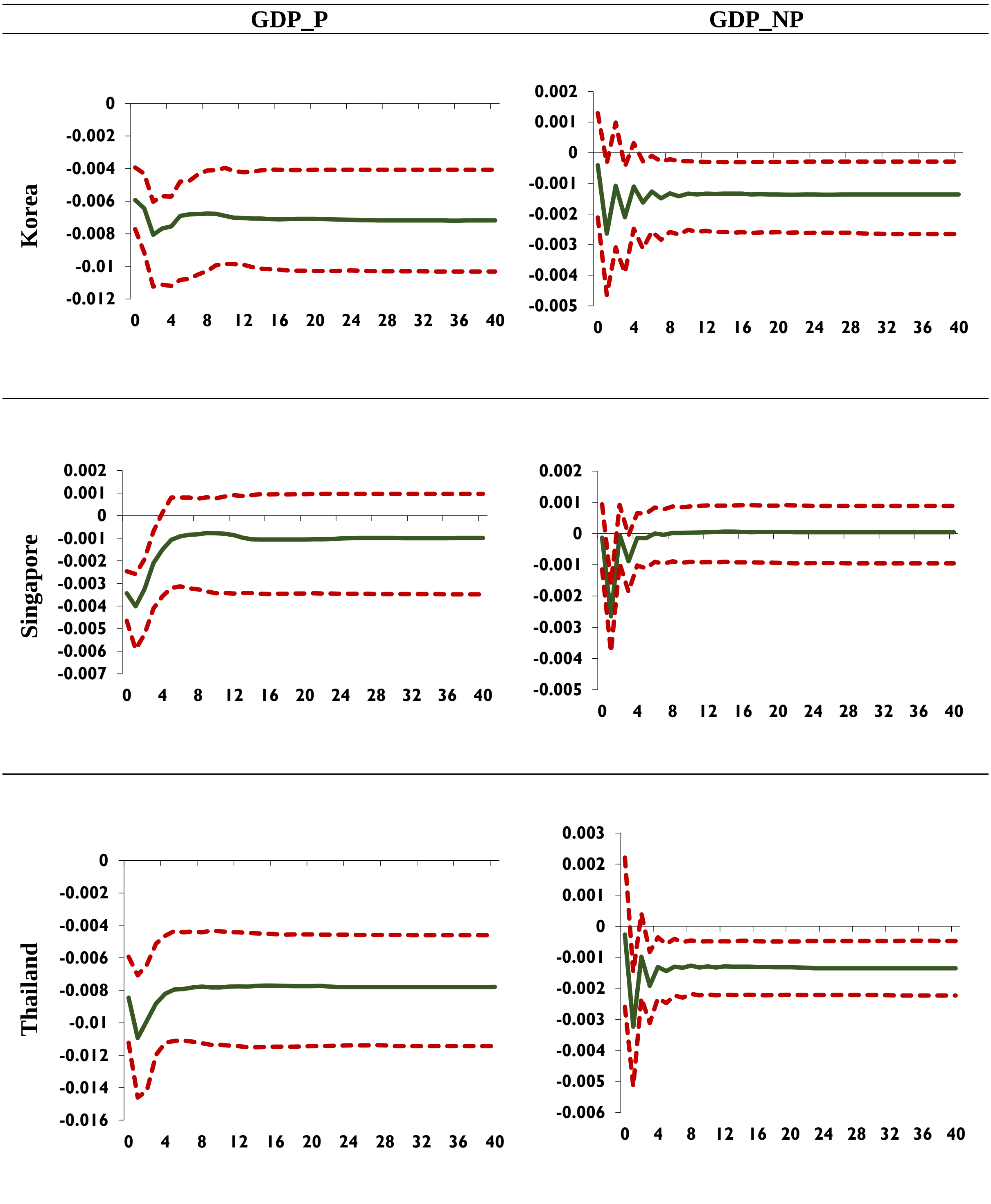
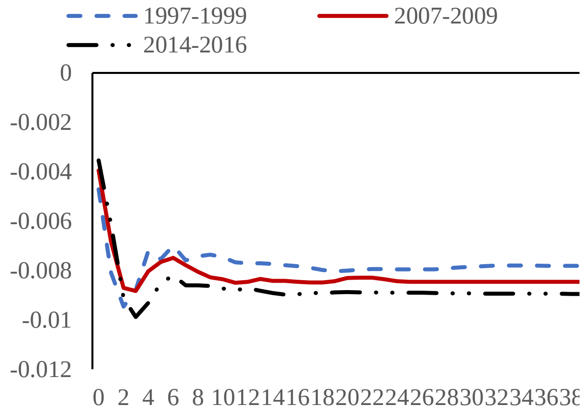


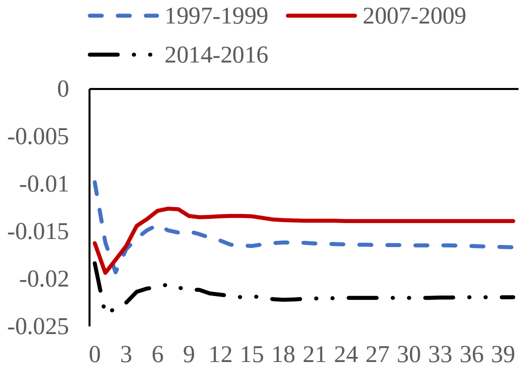
Figure 4.11 and 4.12 display the responses of petroleum and non-petroleum GDP following a negative shock to Oman's trade partners GDP by re-estimating the model using three different trade weights, (1997-1999-, 2007-2009, and 2014-2016). Likewise, using three different trade weights, the petroleum GDP responses are higher than the responses of non-petroleum GDP. By comparing these results, the petroleum GDP falls dramatically within the first six quarters, whereas non-petroleum GDP falls within the first four quarters. Figure 4.11 display the response of petroleum GDP to China's shock is statistically significant and the largest compared to all other economies. The responses to US shocks are all statistically significant and slightly increased with time. In contrast, the response to Japan gradually decrease with time, and the responses to Thailand higher during the AFC period and gradually decrease with time.

The responses of non-petroleum GDP are illustrated in Figure 4.12. Consistent with the response of total GDP and petroleum GDP, a Chinese shock affects the non-petroleum GDP in a much more prominent way compared to other economies. The responses of non-petroleum GDP to the US, China, and Korea are higher using GFC weights, while the response to Japan and Thailand is higher using AFC weights. The response to Singapore is statistically insignificant in all three weights. As it is important to address ways to mitigate the influence of the international economic shocks on the petroleum GDP, it is also important to investigate the channel of impact on the non-petroleum GDP.

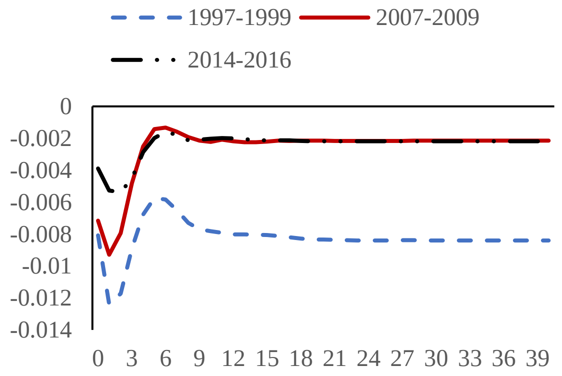
Figure 4.11. The median impulse responses of the Omani petroleum GDP to one standard deviation fall in the trade partners' GDP, using average trade weights (1997-1999, 2007-2009, and 2014-2016)

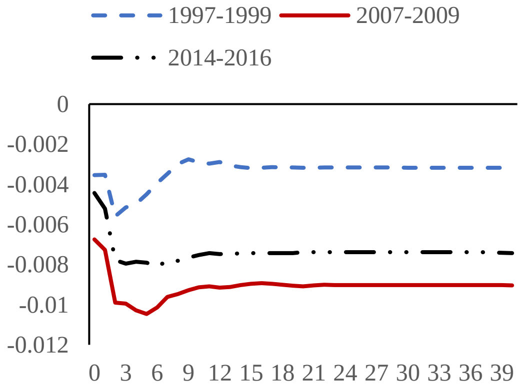
US	China



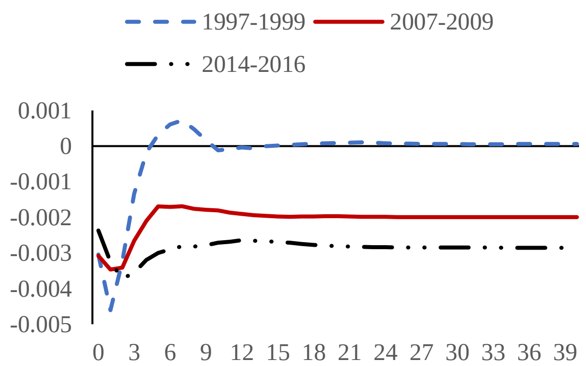


Japan	Korea





Singapore	Thailand



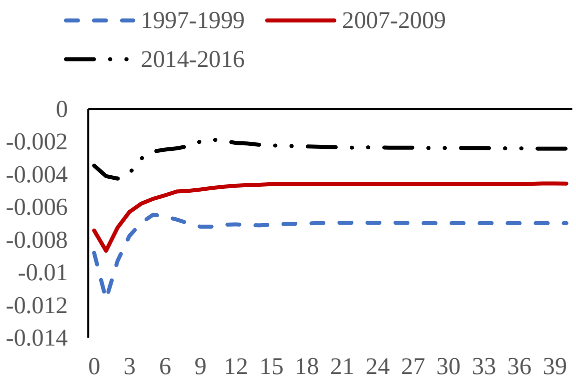
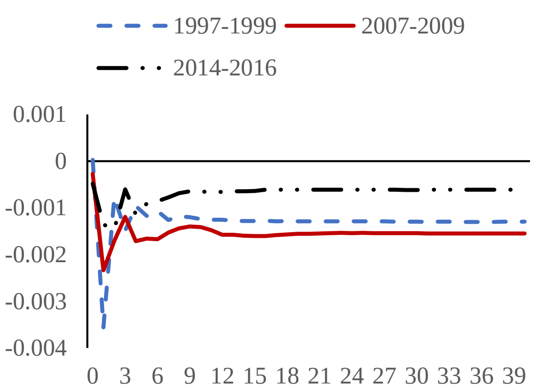
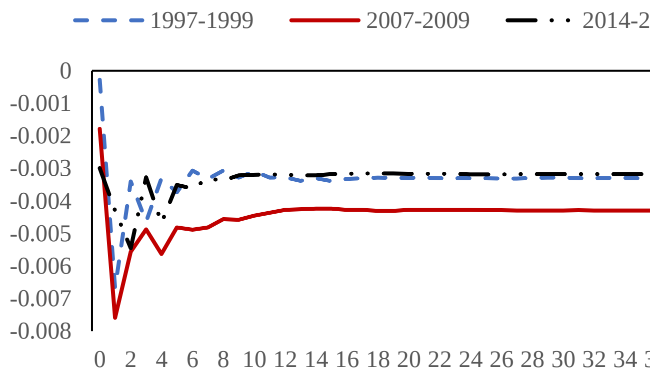


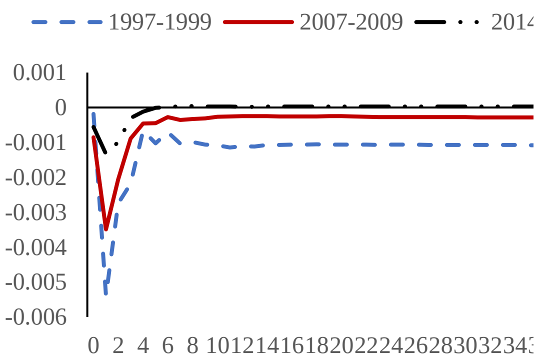
Figure 4.12. The median impulse responses of the Omani non-petroleum GDP to one standard deviation fall in the trade partners' GDP, using average trade weights (1997-1999, 2007-2009, and 2014-2016)

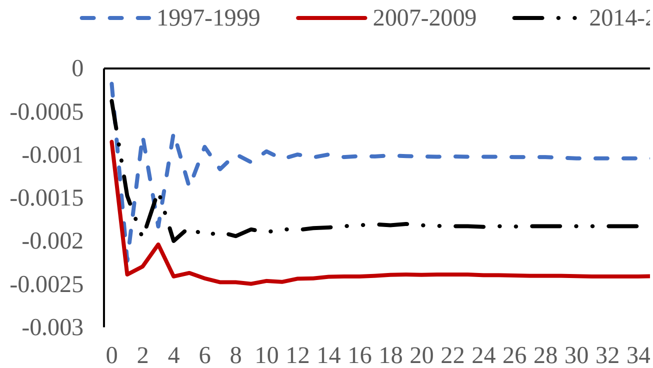
US	China



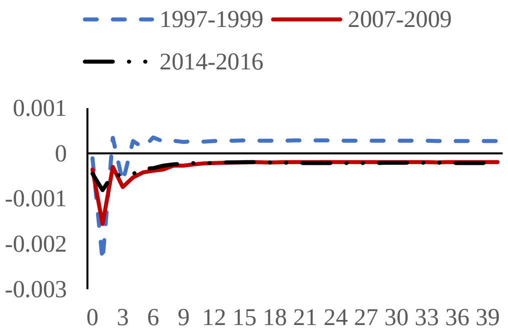


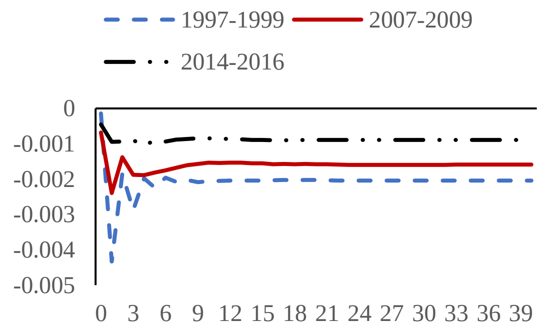
Japan	Korea





Singapore	Thailand





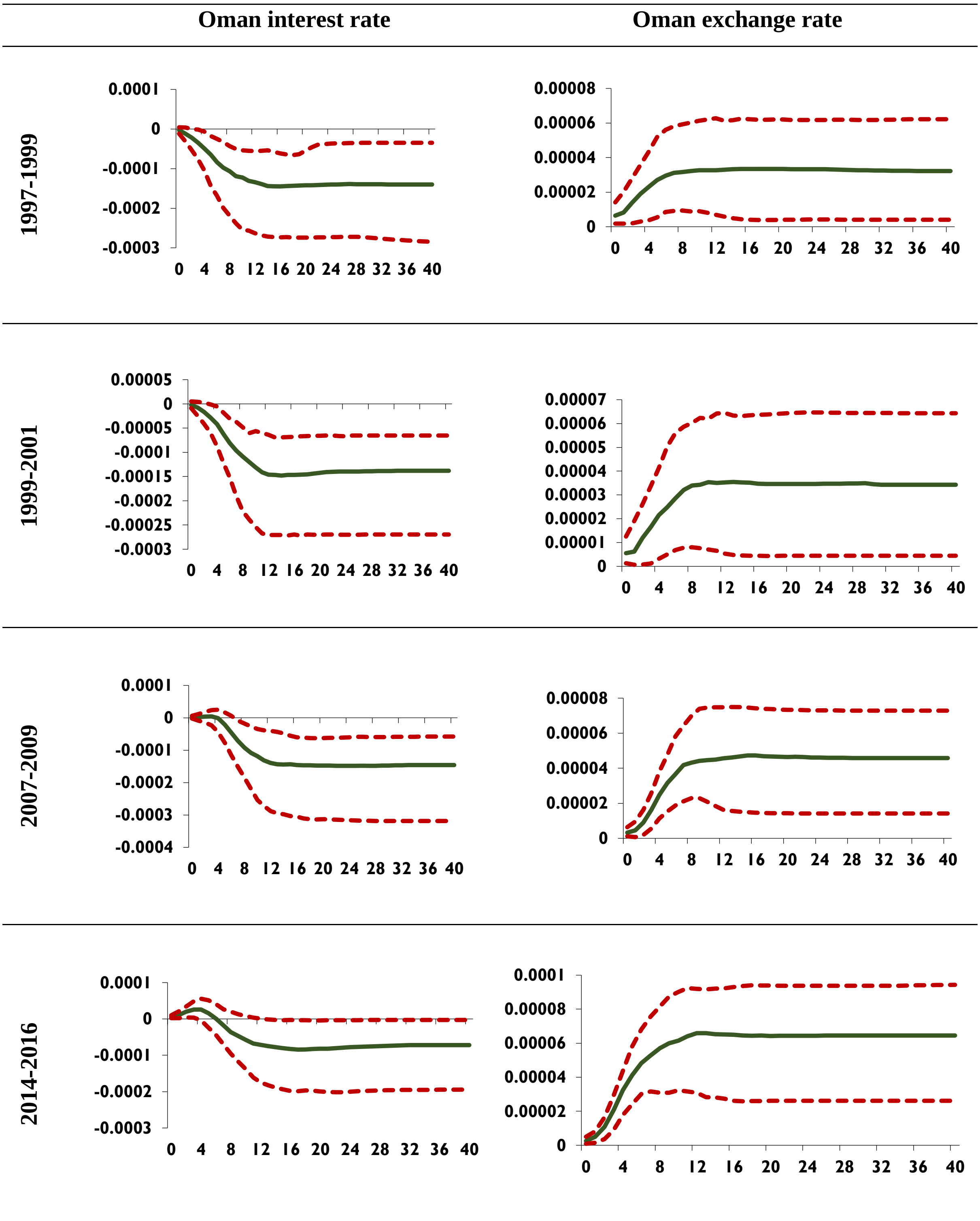
4.4.1.4 GIRFs of the Omani interest rate and exchange rate to shock to the US interest rate[52]

The US monetary policy is important to the world in general and to Oman in particular as the Omani currency is pegged to the US dollar since 1973 (CBO, 2018a)[53]. This sub-section presents the responses of the Omani interest rate and exchange rate to the US expansionary monetary policy shocks. The impact of the US could be direct, as the change in the Federal Reserve is automatically transmitted to monetary policy in Oman due to the currency peg arrangement (CBO, 2019). The US dollar is the main pricing and settlement currency in oil transactions. Therefore, the fluctuations of the dollar plays an important role in world oil prices (Hou et al., 2016), which may affect the Omani economy indirectly, through oil price which is an important commodity for the oil-dependent Oman.

Figure 4.13 shows the responses of Omani interest rate and exchange rate to an expansionary US interest rate shock, illustrated by one negative standard deviation. Overall, the Omani interest rate and exchange rate responded statistically significant to the US interest rate shocks, negative from the former and positive from the latter. The exchange rate, in this case, is the bilateral exchange rate with the US dollar. According to the Mundell-Fleming modelling framework, under the flexible exchange rate regime, an increase/ decrease in the interest rate, will lead to foreign capital inflow/ outflow and consequently an appreciation/ depreciation of the domestic currency (Fleming, 1962; Mundell, 1963). Due to the US expansionary monetary policy, the US dollar depreciates, leading to capital outflow and dollar depreciation, therefore, the Omani Rial appreciate. Consistent with the same currency arrangement of the Omani monetary policy since the early 1970s, the overall influence of the US expansionary monetary shocks is not changing much across time using different trade weights.

[52] This part will not be included when we submit the essay for publication.
[53] The current parity is constant since 1986 at US $ 2.6008 per Omani rial (CBO, 2018a).

Figure 4.13. The median impulse responses of the Omani interest rate and exchange rate to one standard deviation fall in US interest rate, using trade weights (1997-1999, 1999-2001, 2007-2009, and 2014-2016)



4.4.2 The generalized forecast error variance decomposition

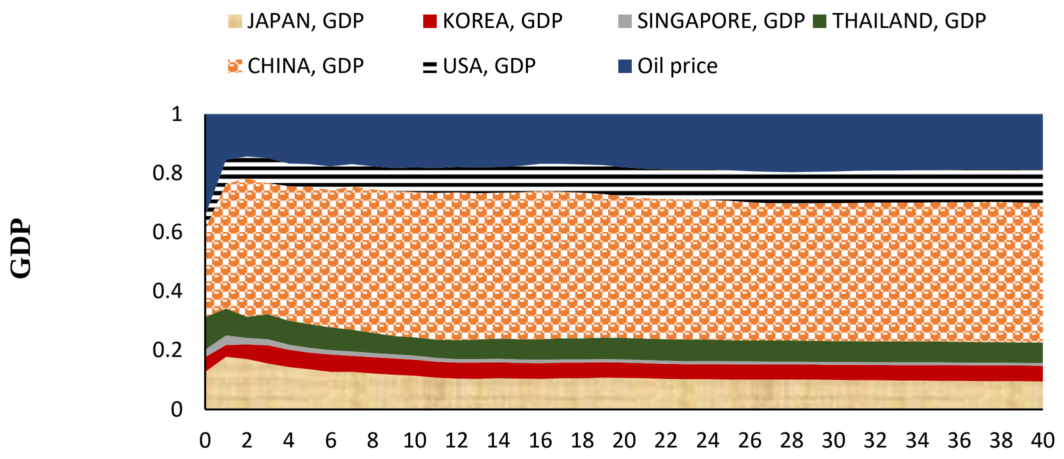
In the VAR model, the forecast error variance decomposition (FEVD) is performed based on a set of orthogonalized shocks and calculate the contribution of the orthogonalized innovation to the mean square error of the n-steps ahead forecast of the model. In the case of GVAR, the shocks across countries are not orthogonal and some evidence shows, on average, they are positively correlated, therefore, here we use the generalized forecast error variance decomposition (GFEVD). The GFEVD is the proportion of n-steps ahead forecast error variance of variable A which is accounted for the innovations in variable B in the VAR (Pesaran & Shin, 1998). Unlike the case of the orthogonal where the FEVD sum to unity, the non-orthogonal shocks do not sum to unity (Chudik & Pesaran, 2016). Moreover, the GFEVD is invariant to the order of the variables allowing for the contemporaneous correlation between the shocks.

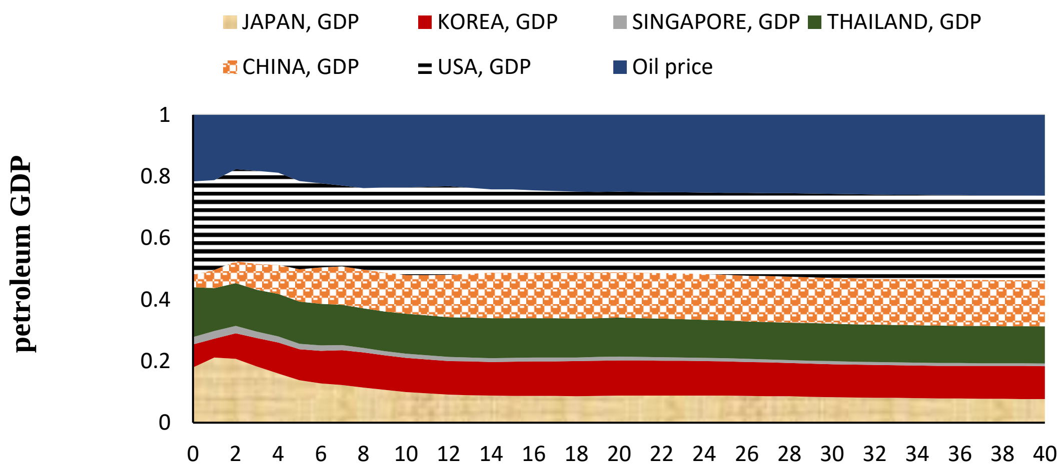
4.4.2.1 GFEVD for Omani GDP, petroleum GDP and non-petroleum GDP

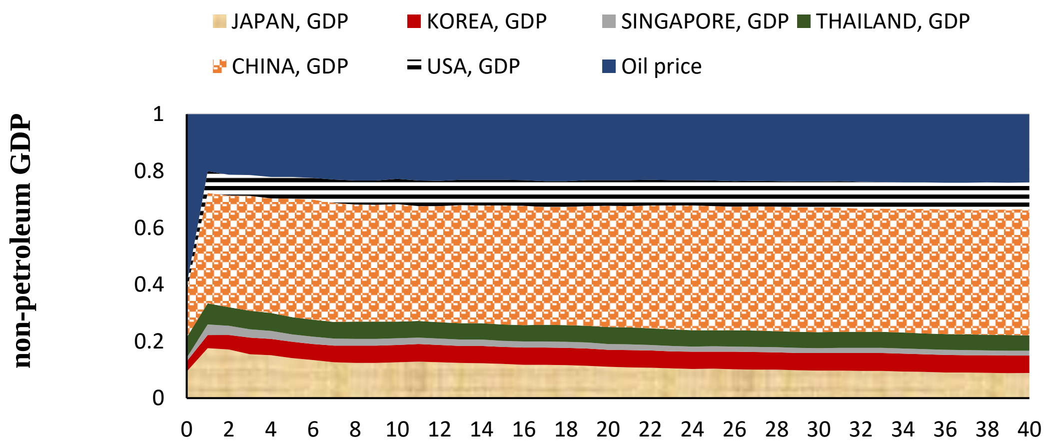
After investigating the responses of the Omani GDP to different shocks, now we will quantify the importance of those shocks. Figure 4.14 shows the relative weights of the different shocks computed using GFEVD over different horizons (40 quarters) for variation in the Omani GDP, petroleum GDP and non-petroleum GDP. Before considering these plots, it is important to bear in mind that these shocks together account for only a small of the total variation in the Omani GDP. As highlighted by Mohaddes and Pesaran (2016) one should note that the GFEVD figures below show the relative share of the shocks, and thus do not represent the absolute importance of such shocks for the Omani economy.

The results reveal that shocks from China play a key role in explaining the variance in Omani GDP. What is surprising is that using average trade weight 1999-2001, the Chinese shocks are more important for non-petroleum GDP compared to petroleum GDP. Oil price also contributes considerably to non-petroleum GDP variance, same as to petroleum GDP variance. This considerable contribution to non-petroleum GDP may be due to government investment, as government expenditure have a dominant role in the market which is planned based on oil price revenue. It may also be due to the petrochemical industry, which classifies as a non-petroleum segment of the GDP. The contribution of all other trade partners is almost same in GDP and its components except for the US, which contributes higher in petroleum GDP compared to non-petroleum.

Figure 4.14. The proportion of GFEVD of the Omani GDP, petroleum GDP, and non-petroleum GDP explained by contemporaneous and future innovations of the country equations using trade weight 1999-2001





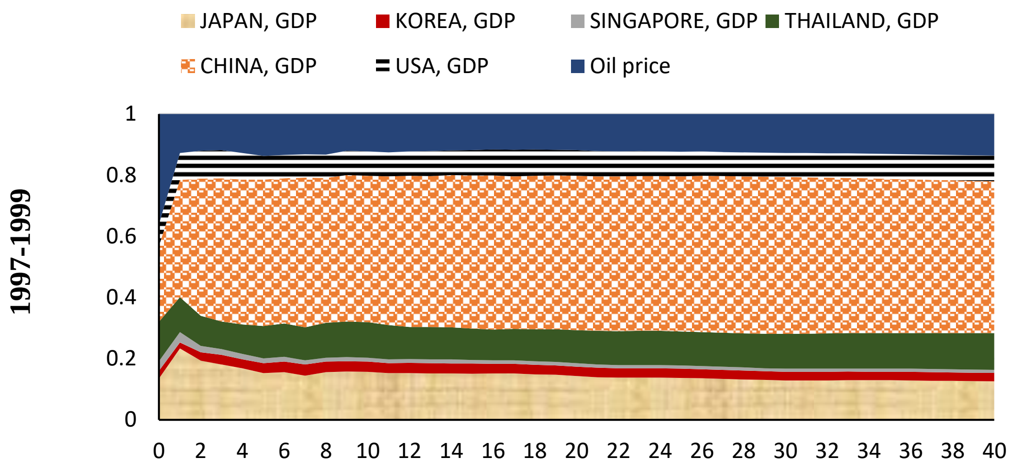


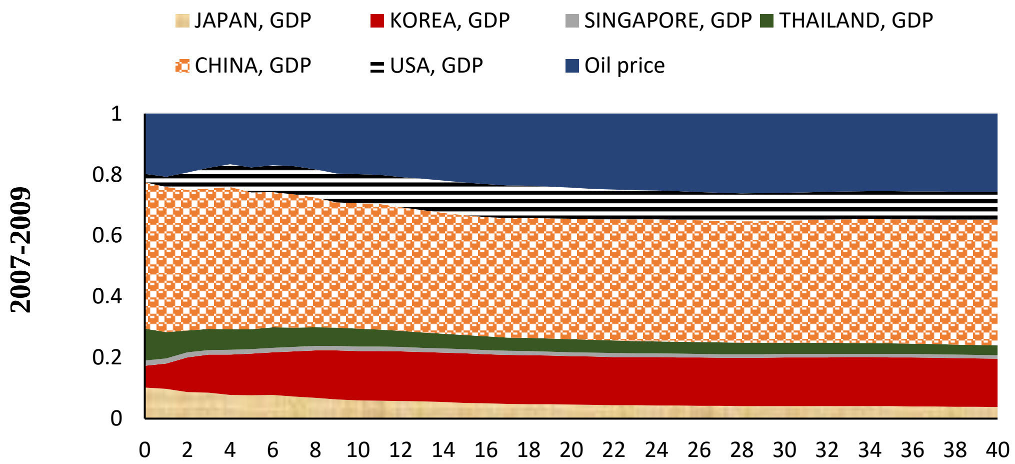
4.4.2.2 The GFEVD using three different trade weights

We re-estimate the model using three different trade weights 1997-1999, 2007-2009, and 2014-2016 for the Omani GDP and its components. Starting with the GFEVD of the Omani GDP using the three different weights, as shown in Figure 4.15. Comparing between the contribution of the trading partners shocks, reveal that the effects of China's shocks are pronounced and stable using different trade weights, reflects the importance of China in Asia. By contrast, the importance of Japan and Thailand becomes less pronounced over time. The pattern of the contribution in Oman's GDP variance from trade partners may differ in the first four quarters then become stable and persist with same contribution pattern over time.

The contribution of China's shocks over three different trade weights is pronounced and stable for non-petroleum GDP, as illustrated in Figure 4.17. The importance of China's shock is increasing over time for petroleum GDP variation, as shown in Figure 4.16, which stems from increasing Omani oil exports to China over the last decade. Interestingly, the importance of China's shocks even outweighs the importance of oil price shocks in petroleum GDP over time. However, oil price shocks contribution to non-petroleum GDP is gradually increasing over time.

Figure 4.15. The proportion of GFEVD of the Omani GDP explained by contemporaneous and future innovations of the country equations using different trade weights





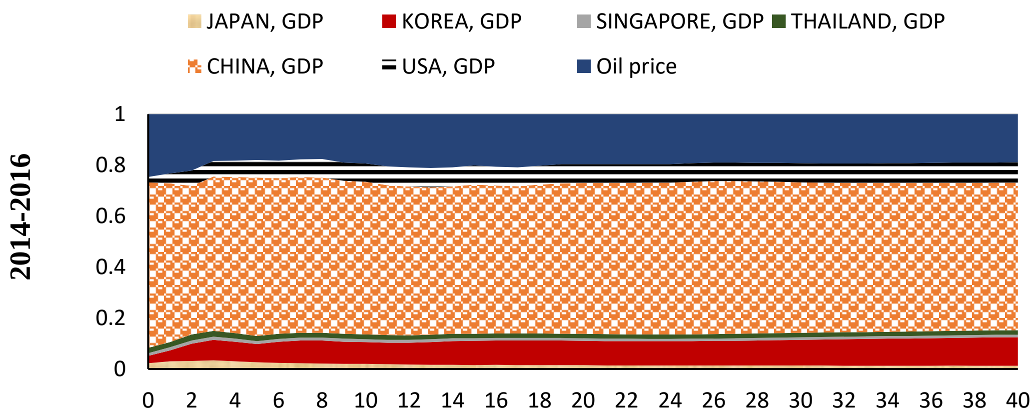
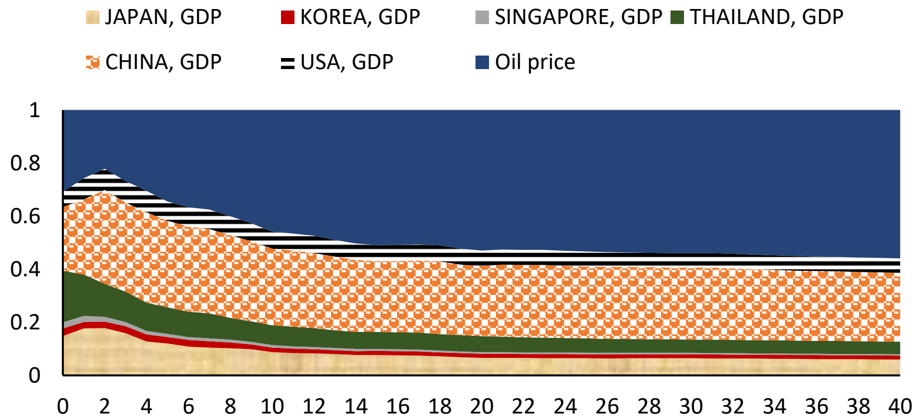
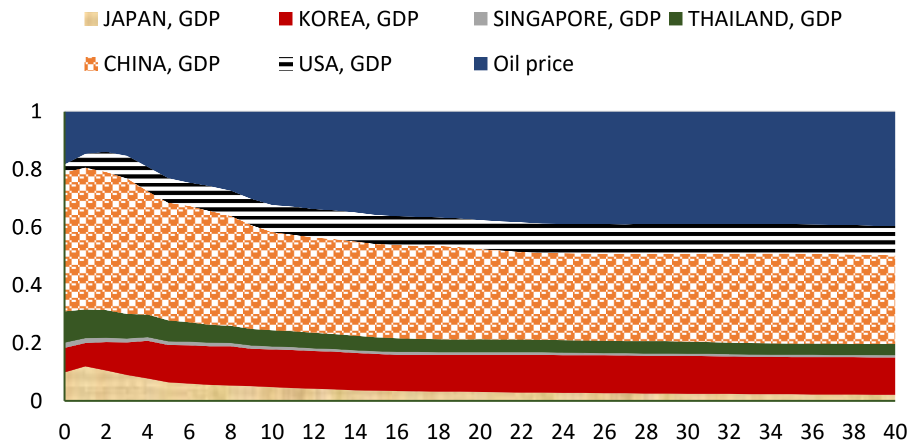


Figure 4.16. The proportion of GFEVD of the Omani petroleum GDP explained by contemporaneous and future innovations of the country equations using different trade weights

1997-1999



2007-2009



2014-2016

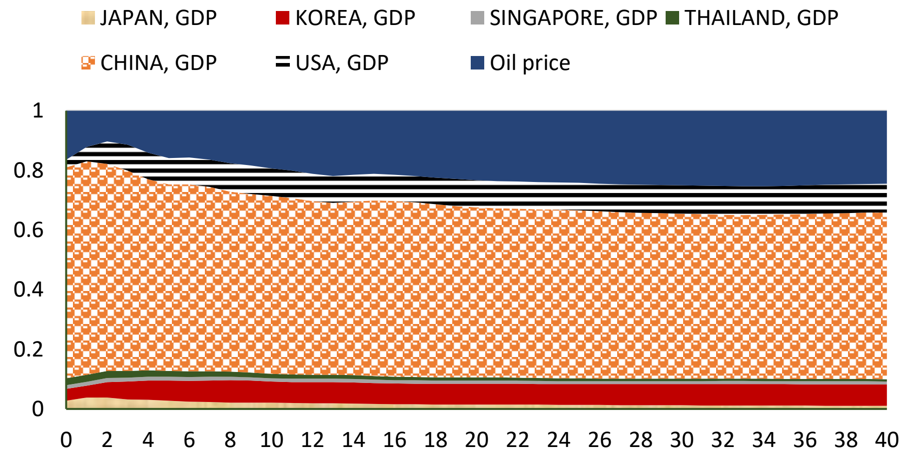
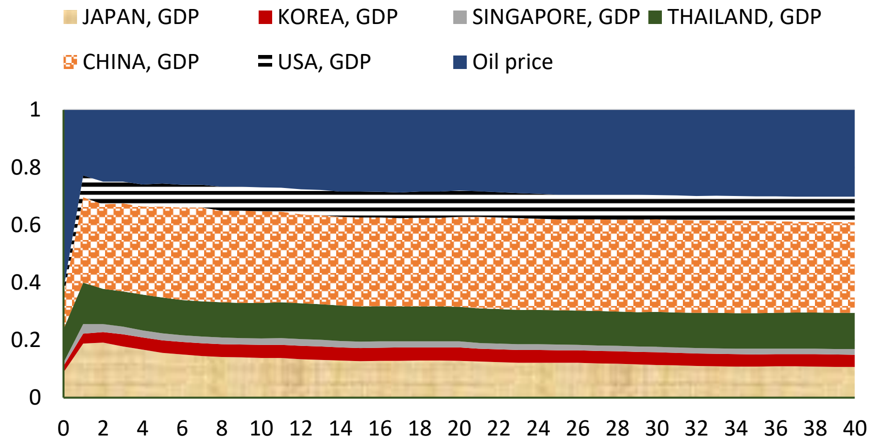
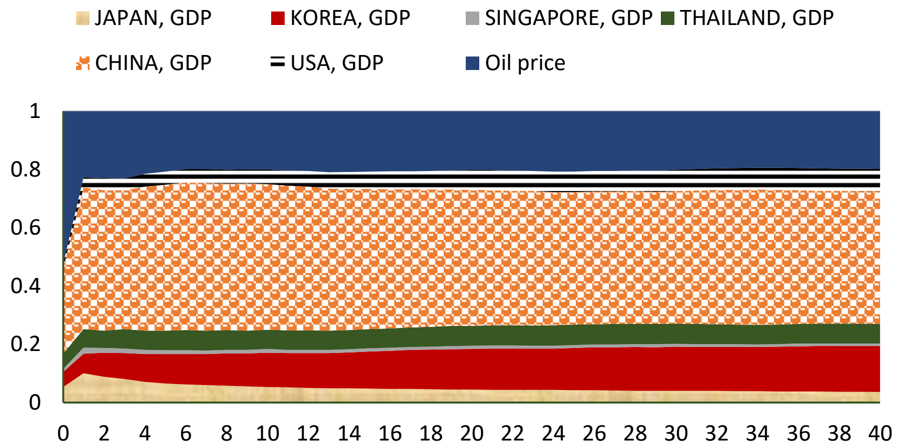


Figure 4.17. The proportion of GFEVD of the Omani non-petroleum GDP explained by contemporaneous and future innovations of the country equations using different trade weights

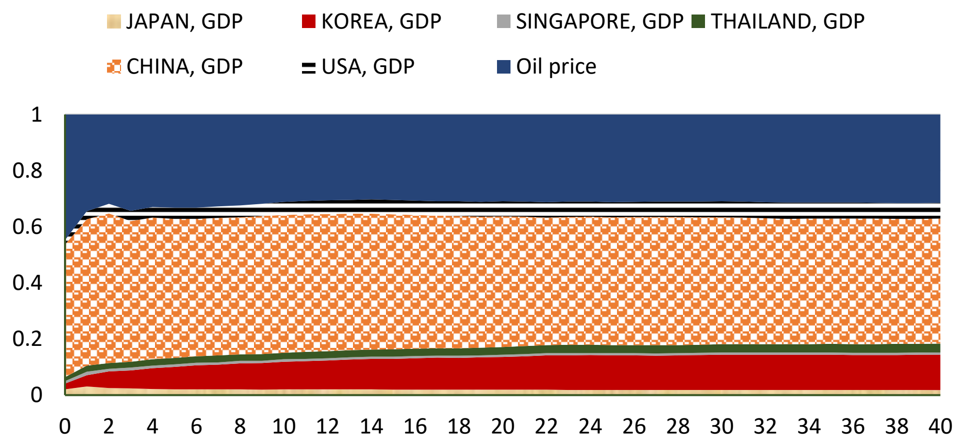
1997-1999



2007-2009



2014-2016



4.5 Conclusion and policy implication

The Omani economy is a small open economy. The exports plus imports as a percentage of GDP is generally more than 90%, classifying it as a super trading nation. The objective of this study is to investigate the effects of shocks on the Omani GDP from its trade partners through trade linkages using the GVAR model. The trade partners are the US, China, Japan, Korea, Thailand, and Singapore, and are the main destinations for the Omani oil. To investigate any changes in the responses of the Omani economy to shocks in trade partners' GDP, we estimate the model using four different trade weights for the period 1989Q4-2016Q4.

Using average trade weights 1999-2001 to estimate the foreign variables and link the GVAR model, the results show the response of Oman's GDP to a shock to China's GDP is substantial and persistent, compared to the other five countries including the US and Japan. The response to all trade partners is statistically significant except for Singapore, which is only statistically significant in the first four quarters.

To reflect the evolving nature of the Omani trade patterns, we used three different trade weights. The results show the influence of China is the highest among all trade partners, and the effect felt most during the Asian Financial Crisis. Compared to that, the influence of US shocks is smaller, but stable across time, while the influence of Japan is declining over time.

Due to the importance of petroleum GDP in the total Omani GDP, which accounts for 40% on average, we examine the impact of international shocks on petroleum and non-petroleum GDP. Generally, the petroleum GDP falls dramatically within the first six quarters, whereas non-petroleum GDP falls within the first four quarters. Using trade weights 1999-2001, the results show that the response of petroleum GDP to the global shocks is higher than the response of non-petroleum GDP. Likewise, the response of the total GDP, the responses of petroleum and non-petroleum GDP is largest to the Chinese shocks compared to shocks from other trading partners. By using different average trade weights, we found China has a greater influence on both petroleum and non-petroleum GDP compared to other trading partners.

Due to the importance of the US monetary policy to the Omani economy as the Omani currency is pegged to the US dollar since 1973, we investigated the response of the Omani interest rate and exchange rate to the US expansionary monetary policy shocks. The results show the Omani interest rate responds negatively and statistically significant to the US accommodative interest rate shocks. In contrast, the Omani exchange rate responds positively and statistically significant to the US interest rate shocks. The US expansionary monetary policy, depreciate the US dollar, leading to capital outflow and dollar depreciation; therefore, the Omani Rial appreciates.

The results of generalized forecast error variance decomposition (GFEVD) reveal the contribution of specific shocks to the variation in the Omani GDP. The results show that Chinese shocks play a key role in explaining the variance in Omani GDP and its components. Using average trade weight 1999-2001, the Chinese shocks are more important for non-petroleum GDP compared to petroleum GDP. Stems from increasing Omani oil exports to China over the last decade, and using different average weights, the importance of the Chinese shock is increasing over time for petroleum GDP variation, and the importance of other countries is declining.

The exports diversification is very important for the Omani economy's stability. The concentration of its exports in one commodity and for one client put the country in a vulnerable situation. Currently, the contribution of petroleum to total exports is high: 57.9%, 58.2%, and 65.3% in 2016, 2017, and 2018, respectively. China is the main oil export destination, account for 77.1%, 78.0%, and 76.9%, in 2015, 2016, and 2017, respectively and up to 83.1% in 2018 (NCSI, 2019). This raises a concern about the Omani economy's vulnerability to its main trading partner. The trade concentration and over-reliance on a particular destination and commodity could be risky for Oman, and thus the Omani government should consider diversifying its trade relation and the composite of products that it exports.

For future work, it will be good to extend the GVAR model to include all trade partners of Oman, and to group these countries into regions. In the current framework, it was not possible to include all trade partners due to lack of data availability. The inclusion of more countries would provide more insights about the shock transmission to the Omani economy due to globalization and provide the policymakers with better information for effective future planning.

4.6 Appendix

Appendix 4.A: Variables description

Variable	Abbreviation	Construction	Data source
Real GDP	y_{it}	$y_{it} = \ln (GDP_{it})$	GVAR database and NCSI for Oman data
Inflation rate	π_{it}	$\pi_{it} = p_{it} - p_{it-1}$ $p_{it} = \ln (CPI_{it})$	GVAR database and NCSI for Oman data
Short-term interest rate	r_{it}^{s}	$r_{it}^{s} = 0.25\ln (1 + R_{it}^{S}/100)$	GVAR database and IFS for Oman data
Long-term interest rate	r_{it}^{l}	$r_{it}^{l} = 0.25ln(1 + R_{it}^{L}/100)$	GVAR database
Real exchange rate	ep_{it}	$ep_{it} = \ln (E_{it}/CPI_{it})$	GVAR database and IFS for Oman data
Equity prices	eq_{it}	$eq_{it} = \ln (EQ_{it}/CPI_{it})$	GVAR database
Oil prices	d_{t}^{oil}	$d_{t}^{oil} = \ln\left(P_{t}^{oil}\right)$	GVAR database

Appendix 4.B: Unit root (ADF) test for domestic and foreign variables

Domestic Variables	OMAN	JAPAN	KOREA	SINGAPORE	THAILAND	CHINA	USA
y (with trend)	-1.28919	-3.00187	-2.13081	-1.94752	-2.62542	-1.36142	-1.35635
y (no trend)	-1.17716	-0.77658	-2.42115	-2.05447	-1.85255	-1.0668	-1.26316
Dy	-6.13349	-6.36763	-5.90505	-5.59277	-6.36378	-3.29332	-4.45962
DDy	-9.75839	-8.40915	-9.43094	-7.75795	-8.49636	-7.98516	-7.37754
Dp (with trend)	-6.48147	-3.83882	-5.12703	-4.1071	-5.83125	-3.02606	-4.49692
Dp (no trend)	-6.41453	-3.85573	-3.72406	-4.1236	-5.16765	-2.62328	-4.0104
DDp	-7.36395	-12.6826	-7.39	-6.74386	-7.93179	-5.71658	-8.81057
DDDp	-9.74234	-8.8002	-8.79074	-8.85534	-8.70838	-9.18223	-10.2874
eq (with trend)		-3.32702	-3.85493	-4.05046	-1.84665		-2.04913
eq (no trend)		-3.45736	-1.50987	-3.52902	-1.82186		-1.79474
Deq		-5.42381	-6.28538	-7.01406	-7.29707		-5.87947
DDeq		-7.37943	-7.0208	-8.04745	-8.26406		-7.58903
ep (with trend)	-1.03109	-2.95915	-3.00224	-1.49349	-2.07046	-2.5849	
ep (no trend)	-1.26785	-2.93842	-1.55449	-1.35822	-1.45549	-0.34075	
Dep	-6.5818	-4.19016	-7.65953	-5.40132	-6.79456	-7.81959	
DDep	-7.36553	-10.4097	-7.70245	-7.85257	-8.36119	-9.13076	
r (with trend)	-2.57517	-3.5259	-2.90327	-4.11252	-3.63117	-1.77059	-4.84395
r (no trend)	-2.0583	-4.40368	-1.71662	-3.16832	-2.93852	-1.25331	-2.31311
Dr	-3.91526	-4.6011	-6.35828	-5.46363	-6.37528	-5.04376	-4.35227
DDr	-6.37744	-6.55796	-8.77847	-8.59537	-7.07841	-7.7263	-5.7997
lr (with trend)		-4.12441	-2.24256				-5.0167
lr (no trend)		-4.82168	-1.09596				-1.5246
Dlr		-5.59199	-8.46738				-6.17058
DDlr		-9.27953	-8.66464				-7.4604

Foreign Variables	OMAN	JAPAN	KOREA	SINGAPORE	THAILAND	CHINA	USA
ys (with trend)	-2.2034	-1.20368	-1.59053	-1.58524	-2.07281	-2.44304	-1.60495
ys (no trend)	-1.57965	-1.79846	-1.22863	-1.45494	-1.32631	-1.51757	-1.32205
Dys	-5.3712	-4.2548	-5.58849	-5.64204	-5.55577	-5.91832	-5.5386
DDys	-7.22133	-7.3618	-7.27458	-7.13506	-7.72784	-7.58587	-7.55078
Dps (with trend)	-3.57332	-3.54533	-3.42433	-3.64781	-3.80765	-5.08066	-2.77286
Dps (no trend)	-3.0072	-3.10359	-3.12385	-3.18716	-3.49324	-4.52998	-2.45934
DDps	-9.61336	-7.79701	-7.13004	-7.28894	-7.1535	-7.62827	-9.28986
DDDps	-8.27404	-10.0175	-9.41285	-9.63857	-8.69989	-8.8396	-8.03498
eqs (with trend)	-3.62181	-2.89474	-2.82608	-3.20994	-3.41923	-3.5783	-3.78225
eqs (no trend)	-3.16344	-1.72756	-2.39034	-2.13893	-2.70897	-2.50136	-3.79609
Deqs	-5.91482	-6.75719	-5.28282	-5.53763	-5.49488	-5.60719	-6.50489
DDeqs	-7.96452	-8.38781	-7.1291	-7.96836	-7.8201	-7.90198	-7.82709
eps (with trend)	-2.14581	-2.00521	-1.59818	-1.94867	-2.03709	-2.61976	-1.65345
eps (no trend)	-1.31462	-0.47835	-1.21777	-1.04113	-1.52776	-2.24732	-1.22879
Deps	-7.34654	-7.35233	-8.28825	-7.72042	-5.14851	-4.9038	-7.91652
DDeps	-8.02892	-8.78914	-8.25307	-8.17219	-7.99171	-8.31869	-8.17598
rs (with trend)	-2.42591	-3.15139	-3.27455	-3.02288	-3.38252	-3.23413	-1.8475
rs (no trend)	-2.15051	-1.81095	-2.28672	-2.04931	-2.62948	-2.75088	-2.06956
Drs	-6.57529	-4.892	-4.35478	-5.47209	-4.10168	-6.78127	-5.311
DDrs	-7.52671	-6.21436	-11.7736	-6.41753	-10.1998	-6.87164	-6.91654
lrs (with trend)	-2.6631	-4.55379	-3.54542	-3.19085	-3.30218	-2.91711	-3.12275
lrs (no trend)	-2.43409	-1.33719	-2.61361	-2.27007	-2.75509	-2.37995	-3.35092
Dlrs	-7.2585	-6.7314	-6.15116	-6.37223	-6.12638	-6.38384	-7.18504
DDlrs	-8.85435	-7.7294	-8.05295	-8.04763	-8.1855	-8.31727	-8.76898

The critical value of ADF statistics with a trend is -3.45, and with no trend is -2.89 at the level 5% of significance.

Appendix 4.C: Unit root (WS-ADF) test for domestic and foreign variables

Domestic Variables	OMAN	JAPAN	KOREA	SINGAPORE	THAILAND	CHINA	USA
y (with trend)	-1.74885	-3.07055	-0.67121	-1.20939	-1.42797	-1.63781	-1.57446
y (no trend)	0.33922	0.812767	1.720734	1.57355	2.136623	-0.25213	0.990011
Dy	-5.90824	-6.41789	-6.02075	-5.80473	-6.44193	-3.17833	-4.6246
DDy	-8.76602	-8.3807	-9.66738	-8.15714	-8.76086	-8.19119	-6.66351
Dp (with trend)	-6.55028	-3.85669	-4.85597	-4.22185	-5.96581	-2.95721	-4.20655
Dp (no trend)	-6.5224	-3.68334	-2.78368	-4.21689	-5.33158	-2.82361	-3.24413
DDp	-7.59209	-12.8585	-7.33365	-6.92522	-8.09625	-5.9092	-8.43541
DDDp	-9.94931	-9.63098	-8.18143	-9.18439	-9.28749	-8.38258	-11.3379
eq (with trend)		-2.57663	-3.07102	-4.22266	-2.12413		-1.98878
eq (no trend)		-2.07327	-1.84461	-3.66203	-2.06468		-0.49347
Deq		-5.16064	-6.33905	-7.16493	-7.43034		-6.03464
DDeq		-7.56612	-7.24997	-8.2872	-8.52883		-7.34748
ep (with trend)	-1.43406	-2.65695	-3.19021	-1.60661	-2.33402	-1.38905	
ep (no trend)	-1.50723	-1.89881	-1.56678	0.273125	-1.34528	-0.65009	
Dep	-6.5781	-4.29507	-7.83412	-5.46056	-6.95985	-7.37028	
DDep	-7.5854	-10.1741	-7.93984	-8.26645	-8.63215	-9.2162	
r (with trend)	-2.68455	-2.13923	-3.14455	-3.65527	-3.70079	-2.00406	-4.94918
r (no trend)	-1.41756	-1.40059	-0.9478	-1.69163	-2.3973	-0.60688	-1.65477
Dr	-4.26055	-3.73101	-6.59139	-5.67705	-6.61365	-4.66775	-4.53925
DDr	-6.62872	-6.52234	-8.99516	-8.02308	-7.20297	-8.59848	-5.54899
lr (with trend)		-1.75699	-2.50409				-5.07316
lr (no trend)		-0.24069	0.143149				-0.22561
Dlr		-4.996	-8.69011				-6.31802
DDlr		-7.4109	-9.04522				-7.38877

Foreign Variables	OMAN	JAPAN	KOREA	SINGAPORE	THAILAND	CHINA	USA
ys (with trend)	-1.77102	-1.55077	-1.84749	-1.6705	-2.06992	-1.85255	-1.75696
ys (no trend)	1.77473	0.288966	1.499577	1.507406	1.650607	1.632581	1.661858
Dys	-5.48843	-4.39657	-5.75378	-5.80156	-5.69088	-5.95577	-5.69366
DDys	-7.43156	-7.35143	-7.54056	-7.39075	-7.9863	-7.82937	-7.73452
Dps (with trend)	-3.72254	-3.70128	-3.60457	-3.80949	-3.9948	-4.80147	-2.90023
Dps (no trend)	-3.16621	-3.27081	-3.27849	-3.34179	-3.56566	-3.73163	-2.68513
DDps	-9.51256	-7.93342	-6.48783	-6.77965	-6.77506	-7.6072	-9.24459
DDDps	-8.34417	-9.83088	-9.26163	-9.50097	-8.8167	-9.46413	-7.8578
eqs (with trend)	-3.22804	-3.02035	-3.01887	-3.36141	-3.47142	-3.51282	-3.12553
eqs (no trend)	-3.10611	-0.96356	-2.40072	-2.26077	-2.91808	-2.71889	-3.13503
Deqs	-5.81593	-6.90509	-5.14662	-5.44544	-5.33868	-5.40519	-6.56406
Ddeqs	-8.18227	-8.54498	-7.14947	-8.10402	-7.95299	-8.0552	-8.0298
eps (with trend)	-2.39759	-1.582	-1.91508	-2.17944	-2.29221	-2.61274	-1.96383
eps (no trend)	-0.65316	-0.5449	-0.41322	-0.54049	-0.63614	-1.32532	-0.46079
Deps	-7.33022	-7.15896	-8.01055	-7.48659	-5.31072	-5.08944	-7.73127
DDeps	-8.13528	-8.9118	-8.25941	-8.26285	-7.96507	-8.48732	-8.20883
rs (with trend)	-2.16704	-3.17772	-2.87928	-2.70613	-2.3534	-2.23447	-1.51797
rs (no trend)	-0.35455	-0.26114	-0.62234	0.070544	-0.04946	-0.04069	0.14545
Drs	-6.71426	-5.16378	-4.51196	-5.78984	-4.29078	-6.79111	-5.58014
DDrs	-8.37076	-6.52901	-11.5931	-6.61339	-10.0835	-8.03022	-7.3232
lrs (with trend)	-2.05608	-4.71146	-2.64591	-2.55305	-2.29493	-2.21444	-1.86539
lrs (no trend)	0.352276	0.24598	0.080047	0.318497	0.228989	0.427476	0.163563
Dlrs	-6.67945	-6.85014	-6.0482	-6.25817	-5.913	-6.18772	-5.86251
DDlrs	-8.53864	-7.87595	-7.37529	-7.63884	-7.48716	-7.92805	-7.82636

The critical value of WS-ADF statistics with a trend is -3.24, and with no trend is -2.55 at the level 5% of significance.

Appendix 4.D: Unit Root tests for the global variable

Global Variables	Test	Statistic	Test	Statistic
poil (with trend)	ADF	-0.82726	WS-ADF	-1.10647
poil (no trend)	ADF	-1.46344	WS-ADF	-1.48886
Dpoil	ADF	-5.48346	WS-ADF	-5.60593
DDpoil	ADF	-8.36274	WS-ADF	-8.50286

Appendix 4.E: Trace statistics and critical values for trace statistics

Country	OMAN	JAPAN	KOREA	SINGAPORE	THAILAND	CHINA	USA
Endogenous variables	4	6	6	5	5	4	6
Exogenous variables	6	6	6	6	6	6	3
r=0	139.4192	227.4244	347.8188	213.7379	243.7466	137.9331	217.236
r=1	86.78835	165.9959	232.0777	142.6931	147.8682	77.69921	150.4289
r=2	44.58836	109.983	153.1386	80.69376	84.7006	36.3349	103.6622
r=3	15.4152	65.80142	85.88718	37.36008	45.8828	11.87299	62.46191
r=4		29.84875	40.01043	12.38678	20.50946		31.40411
r=5		12.34299	17.14006				9.902111

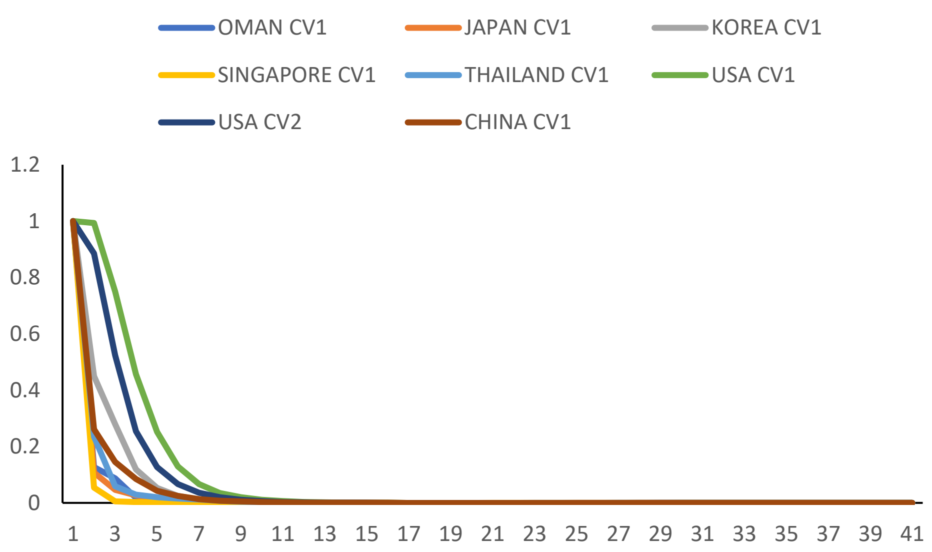
Details statistics for testing cointegration for country-specific models

Critical Values for trace statistics

Country	OMAN	JAPAN	KOREA	SINGAPORE	THAILAND	CHINA	USA
Endogenous variables	4	6	6	5	5	4	6
Exogenous variables	6	6	6	6	6	6	3
r=0	119.03	197.7	197.7	156.44	156.44	119.03	158.01
r=1	85.44	156.44	156.44	119.03	119.03	85.44	122.96
r=2	55.5	119.03	119.03	85.44	85.44	55.5	91.81
r=3	28.81	85.44	85.44	55.5	55.5	28.81	64.54
r=4		55.5	55.5	28.81	28.81		41.03
r=5		28.81	28.81				20.98

The critical values at the 5% significance level MacKinnon et al. (1999).

Appendix 4.F: Persistence profiles

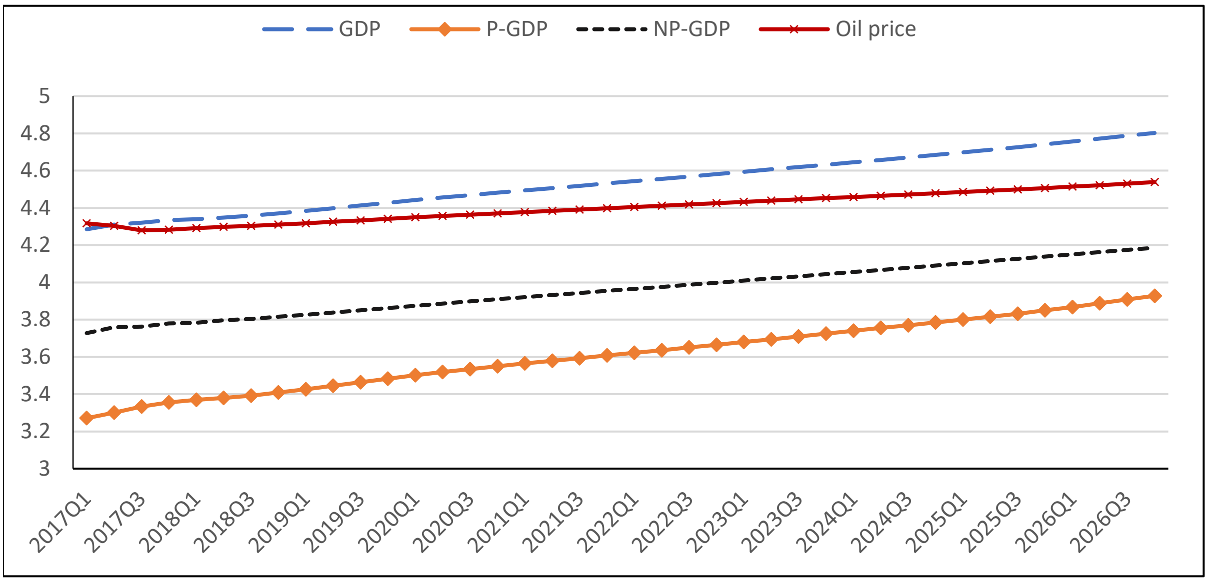


Appendix 4.G: Trade weight matrices

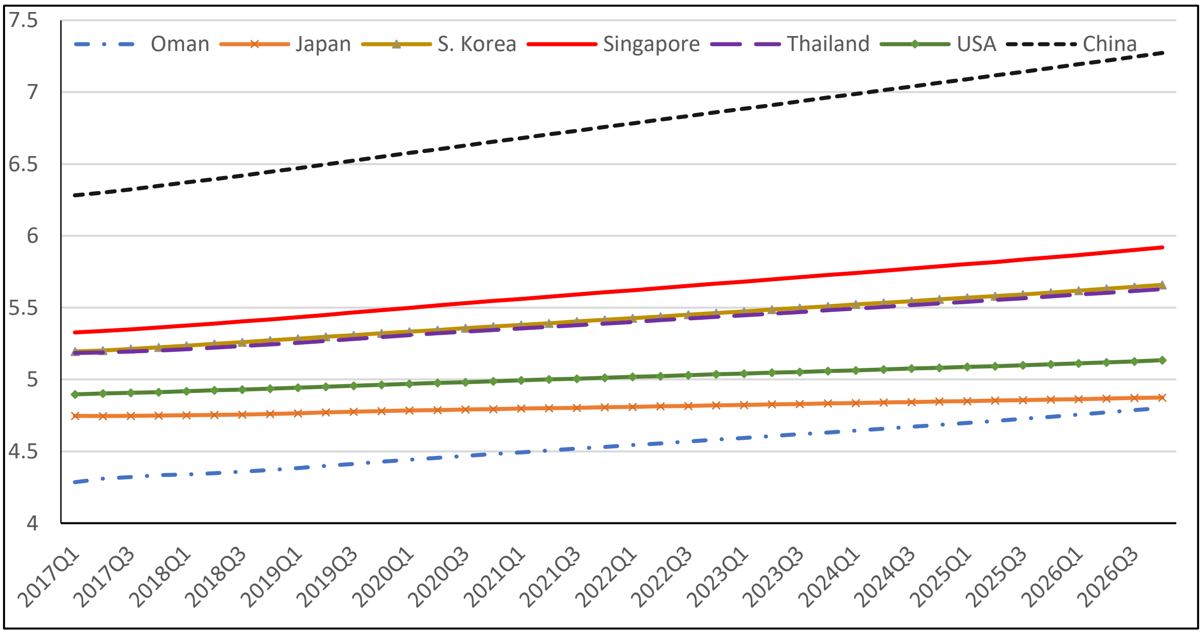
Average trade weight 1997-1999							
Country	OMAN	JAPAN	KOREA	SINGAPORE	THAILAND	USA	CHINA
OMAN	0	0.0057	0.0072	0.0017	0.0186	0.0011	0.006
JAPAN	0.3604	0	0.2695	0.23	0.327	0.4081	0.4019
KOREA	0.1613	0.0891	0	0.0584	0.0418	0.1042	0.1528
SINGAPORE	0.0211	0.0559	0.0512	0	0.128	0.0776	0.0552
THAILAND	0.1897	0.0514	0.0207	0.0881	0	0.0431	0.0246
USA	0.0751	0.4804	0.3616	0.3509	0.2964	0	0.3596
CHINA	0.1923	0.3176	0.2899	0.271	0.1881	0.3659	0
Average trade weight 1999-2001							
Country	OMAN	JAPAN	KOREA	SINGAPORE	THAILAND	USA	CHINA
OMAN	0	0.0062	0.0109	0.0029	0.0158	0.0011	0.0094
JAPAN	0.3252	0	0.2708	0.2271	0.3273	0.383	0.3931
KOREA	0.1987	0.0999	0	0.0686	0.0443	0.1168	0.1582
SINGAPORE	0.0381	0.052	0.0474	0	0.12	0.0678	0.0502
THAILAND	0.1297	0.0501	0.0198	0.0856	0	0.0421	0.0299
USA	0.0567	0.4515	0.3508	0.3251	0.2885	0	0.3591
CHINA	0.2516	0.3403	0.3004	0.2908	0.204	0.3891	0
Average trade weights 2007-2009							
Country	OMAN	JAPAN	KOREA	SINGAPORE	THAILAND	USA	CHINA
OMAN	0	0.0101	0.0134	0.0023	0.0184	0.0026	0.0105
JAPAN	0.2344	0	0.2081	0.1402	0.3014	0.2278	0.2977
KOREA	0.1958	0.1133	0	0.1027	0.0579	0.0948	0.2044
SINGAPORE	0.0279	0.0426	0.0556	0	0.0991	0.051	0.06
THAILAND	0.1061	0.0626	0.0223	0.0814	0	0.0369	0.0464
USA	0.0703	0.2795	0.2015	0.2155	0.1834	0	0.3811
CHINA	0.3656	0.4919	0.4991	0.4579	0.3399	0.5869	0
Average trade weight 2014-2016							
Country	OMAN	JAPAN	KOREA	SINGAPORE	THAILAND	USA	CHINA
OMAN	0	0.0074	0.0081	0.0022	0.0069	0.0028	0.0149
JAPAN	0.1123	0	0.1476	0.1079	0.254	0.1788	0.2259
KOREA	0.12	0.1022	0	0.1052	0.0566	0.1035	0.2143
SINGAPORE	0.0279	0.0378	0.0498	0	0.0778	0.0419	0.0605
THAILAND	0.0358	0.0671	0.0227	0.0667	0	0.036	0.0587
USA	0.0629	0.2691	0.2194	0.177	0.1791	0	0.4258
CHINA	0.6411	0.5164	0.5524	0.5411	0.4255	0.6369	0

Appendix 4.H: Forecast to 2026Q4 based on last date in-sample estimation 2016Q4

Forecast of Omani GDP, petroleum and non-petroleum GDP and oil price



Forecast of Omani GDP and their trade partners



CHAPTER 5

5 CONCLUSION

5.1 Summary of findings and policy recommendations

This dissertation analysed the impact of oil prices on the fiscal policy, external balance, and the transmission of external shocks to the Omani economy through trade linkages. The main findings of the thesis are summarised below.

Chapter Two investigated the impact of oil price shocks on the Omani economy and its fiscal measures using the SVAR model. The findings show that oil price shocks have a significant impact on government revenue and GDP. Interestingly, the impact of oil price shocks on the government expenditure is weak and marginal, although it responds significantly to a government revenue shock. The high portion of salaries in government spending, establishment of the saving fund, and the use of local and international debt to smooth the government spending are possible reasons to explain this weak response. On the other hand, as expected, government revenue, government expenditure, and GDP respond negatively and significantly when replacing the oil price with oil price volatility.

The petroleum components of GDP and government revenue responded more to oil price shocks compared with the non-petroleum related components. In addition, the oil price has an impact on the non-petroleum GDP, possibly through the petrochemicals industry. Surprisingly, government investment spending responds negatively to the oil price and government revenue shocks. This may be caused by changes in the fiscal policy in Oman from procyclical to countercyclical between 2000 and 2009. Alternatively, it may be an indicator that the amount allocated for government investment expenditure is not sufficient to create long-term sustainable gain as the GDP responds negatively and only marginally to the government investment spending. This can also be associated with crowding-out effects, and thus requires more investigation. Oil price volatility has no impact on investment spending, which can be associated with the long-term nature of the investment expenditure plans.

Managing large size government in oil-exporting countries can be a challenge, particularly during the oil price plunge. Falls in oil prices with no balance between government revenue and expenditure can be associated with gradual increases in the fiscal breakeven price. This leads to a budget deficit, high debt, and depletion of reserve funds. These outcomes have a negative impact on the economic stability and legacy for future generations.

Chapter Three examined the Twin Deficit Hypothesis for the Omani economy, i.e. testing the relationship between Oman's fiscal and trade balances and oil price in the short-run using the SVAR model, and in the long-run using the SVECM model. The results show that in the short-run, Oman's trade balance and fiscal balance are mostly determined by oil price movements, where both balances respond positively to oil price shocks and negatively to oil price volatility shocks. The trade balance's response to oil price shocks is quantitatively larger compared to fiscal balance, while fiscal balance's response to oil price volatility shocks is larger than trade balance. The fiscal balance responds positively and significantly to trade balance shocks, while the responses of the trade balance to the fiscal balance shocks are marginal. In the dynamic long-run analysis, oil price shocks have a significant impact on fiscal revenue, exports, and imports. These results provide evidence that in Oman, the casual effect runs from the trade balance to the fiscal balance. Oman's trade balance is dominated by oil export, which is an exogenous variable in the domestic economy, being influenced by global oil prices and global trends. In comparison, the fiscal balance is more endogenous, and the Omani government is able to adjust the fiscal policy in response to fluctuations in the oil price and trade balance, thus contradicting the traditional twin deficit hypothesis.

We argue that for an oil-dependent small open economy, like Oman, policies that help to diversify away from depending heavily on oil revenue would help the economy to absorb international oil price shocks more effectively. High contribution to petroleum in exports and government revenue, the leakage of saving in the form of foreign workers' remittance, and elevated external debt due to growing fiscal deficit, cause fragile stability for Oman's internal and external balance. Government spending consolidation and export diversification are important to maintain the internal and external balances for the Omani economy, and to reduce the imbalances. Same policies may not work for all kinds of economies; thus, it is important to consider the right policy harmony with the economic structure and consideration.

Chapter Four studied the impact of the global shocks transmitted through the trade linkages to the Omani economy using a GVAR model. To reflect the evolution of the Omani trade pattern over time, we used four different trade weights to estimate the foreign variables and link the GVAR model. The finding of this essay showed the influence of Chinese-generated shocks on the Omani economy is pronounced across time. Compared to that, the influence of the United States is modest but stable across time, while the influence of Japan is declining over time.

The empirical results also highlight that any unexpected shocks originating from East Asian economies or the US economy have a higher impact on the petroleum GDP compared to the non-petroleum GDP. Generally, the petroleum GDP falls dramatically within the first six quarters, whereas non-petroleum GDP falls within the first four quarters. Same as the responses of the total GDP, the responses of petroleum and non-petroleum GDP are largest to the Chinese shocks compared to shocks from other trading partners. Finally, due to the importance of the US monetary policy to the Omani economy, as the Omani currency is pegged to the US dollar since 1973. The Omani interest rate and exchange rate respond significantly to the US accommodative interest rate shocks. The trade concentration and over-reliance on a particular destination and commodity could be risky for Oman, and thus the Omani government should consider diversifying its trade relation and the composite of products that it exports.

In conclusion, this dissertation provides a deeper understanding of the impact of global shocks on the Omani economy through oil prices and trade linkages. In all three chapters, we provide empirical evidence of the interactions of oil price, trade patterns, with the Omani macroeconomic variables and policies.

5.2 Future research directions

Based on the empirical analysis carried out in Chapters Two, Three, and Four, this dissertation suggests the following research directions.

Chapter Two shows that Oman has high government operating expenditure, and this spending is inflexible and results in high economic costs. This increases the burden on the government, and its ability to adjust to oil price plunge and the slow fiscal consolidation leads to high public debt and debt service costs.

In 2020 the government decided to retire at least 70% of public sector employees who spend 30 years or more in the government. The government also tightens the salaries in the public sector. Given these measures, there are two possible outcomes of this new policy on the employment environment. First, it might minimise the competitiveness between the public sector and the private sector, which could encourage Omani people to work in the private sector. On the other hand, the private sector could downgrade their incentives, and become less popular compared to the public sector, therefore less attractive to the Omani. This would be an interesting area to explore for future work, especially with the new regulation that does not match the academic qualifications with the minimum wages in the private sector.

In Chapter Three, due to data limitation, the trade balance is used instead of the current account balance, though the worker remittances and public debt are recommended to investigate for future research. The Central Bank of Oman’s annual reports points out that the debt to GDP ratio and debt service ratio are inched up dramatically between 2014 and 2018, coupled with a high fiscal deficit. In addition, high leakage from domestic saving is observed in the form of worker remittances, where a high percentage of employees in the private sector are non-Omani. Therefore, an interesting addition to the study would be to consider the debt and saving leakages to examine their impact on fiscal and external imbalances.

From Chapter Four, we can deduce that the concentration of oil exports to China has both pros and cons. On one hand, China is a growing economy, and thus secures a market for Omani oil. On the other hand, the concentration of oil exports to one trade destination put the Omani economy in a vulnerable position. Thus, more investigation into this dilemma will be a valuable addition to the literature. Additionally, it would be beneficial to extend the current investigation to include all Omani trading partners, and group these countries into regions. The extended framework will give more insight into the shocks transmitted to the Omani economy due to globalization and provide the policymakers with better information for more accurate future planning.

Given the current global situation, it is imperative to assess the efficiency of petroleum added value projects, such as refinery operations, in insulating the oil-dependent economies from oil price shocks. The recent oil price drop was due to the economic consequences of COVID-19 pandemic in all sectors, including the oil refinery sector. COVID-19 is a current example of how our world is closely connected, as it is expanded from a single case in China to a global pandemic in less than a few months.

The pathway of the pandemic, the intensity and efficiency of containment efforts, the extent of supply disruptions, the repercussions of the dramatic tightening in global financial market conditions, shifts in spending patterns, human behavioural changes, level of confidence, and volatile commodity prices are notable factors that cause the extreme uncertainty for the global oil market. Moreover, it is also hard to predict the interaction between these factors and their implications on oil exporters.

This health crisis results in supply and demand shock caused by disruption, lockdown, and quarantines. This disruption reduced the economic activity caused by a negative productivity shock. On the demand side, aspects like increased uncertainty, loss of income, fear of contagion causes the reluctance to spend. Therefore, there was a drop in the international demand for the global supply and demand for dry bulk shipping stocks. The shocks amplified through the international trade and financial linkages, dampening global activity, and pushing the commodity prices down.

Moreover, the oil price collapse in 2020 is due to global slowdown results in a steep contraction in oil demand particularly for transportation fuels like jet fuel, gasoline, and diesel, and a significant refinery cut worldwide. Consequently, the growth of the oil-exporting countries slows down not only due to the COVID-19 consequences, but also due to commodity prices plunge. These consequences are expected to weigh heavily on oil exporters with undiversified revenues and exports, particularly on high-cost producers like Oman. Therefore, the effects of COVID-19 pandemic and global oil price movement on Oman and other similar oil exporters could be investigated in the future by expanding the modelling framework used in this thesis.

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